GUIDE

TO Energy Performance Contracting

MEASUREMENT AND VERIFICATION OF ENERGY SAVINGS IN ENERGY PERFORMANCE CONTRACTING

Supplement 1

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DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

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GUIDE TO ENERGY PERFORMANCE CONTRACTING

Supplement 1

Measurement and Verification of Energy Savings in Energy Performance Contracting

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MEASUREMENT AND VERIFICATION

OF ENERGY SAVINGS IN

ENERGY PERFORMANCE CONTRACTING

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Measurement and Verification of Energy Savings
In Energy Performance Contracting

Table of Contents

Purpose	1
Introduction	1
Overview of M&V Theory	2
Defining "Savings"	4
International M&V Options	6
Issues Particular to Hawaii	8
The M&V Plan	9
The Energy Baseline	10
Energy → Dollars	11
Rate Structures	12
Changes in Rates or Rate Structure	12
Savings Guarantee	13
Integrated Survey - Design - Audit/M&V Tools	14
Definitions	15
Model Procurement Language	21
Appendix I. Facilities Data Requirements	
Appendix II. IPMVP M&V Guidelines	
Appendix III. Analysis Spreadsheets	

Measurement and Verification of Energy Savings In Energy Performance Contracting

Performance contracting is an agreement between a Building Owner (or Facilities' Manager) and a private energy services company (ESCo) that uses future energy savings to pay for the entire cost of a building's energy efficiency retrofits. A Building Owner contracts with an ESCO, that then designs, purchases, installs and maintains energy-saving equipment. The ESCO will guarantee that the energy savings achieved—which may include replacing lighting equipment, modifying or replacing boilers and chillers, installing modern energy management control systems, replacing motors—will pay for all project costs.

Purpose

The purpose of this chapter is to help the Owner's representative understand Measurement and Verification (M&V) terminology, options and application issues used for energy performance contracting. This material supplements Chapter 7 of the July 1998 "Guide to Energy Performance Contracting."

Introduction

Measurement and Verification (M&V) procedures, when implemented, allow Owners, Energy Service Companies (ESCos), and financiers to quantify the operation of Energy Efficiency Measures (EEMs) and to calculate the performance and savings. Ideally, savings will be determined by comparing energy use before and after an energy

retrofit and adjusting for all non-retrofit changes that affect energy use. The option selected should be based on the most cost-effective method of measuring the installed EEMs. It is important to realize that no two projects are identical and the options and methods used to measure and verify savings need to be tailored to the EEMs and facility. The cost of the M&V option may have more to do with its selection than the absolute accuracy of the option.

International efforts to streamline the process of determining savings resulted in two M&V documents, the International Performance Measurement and Verification Protocol (IPMVP) (1997), and the FEMP M&V Guideline (1996) (the first application of the IPMVP). Both of these documents are designed to provide a framework that could be applied to the widest variety of projects.

The following material contains a short overview of current M&V theory, international M&V Options, a review of issues that arose in the Hawaii experience, suggestions for future improvements in the M&V process, and definitions of M&V terminology. Facilities data requirements (Appendix I), a copy of the IPMVP, "Measurement and Verification Guidelines: A Generic Application of the IPMVP" (Appendix II), which discusses how to apply the IPMVP principles to energy saving performance contracting, and copies of sample analysis spreadsheets (Appendix III) are included in the appendix.

Overview of M&V Theory

Measurement and Verification (M&V) is concerned with measuring the operation and verifying the performance of the installed equipment. The purpose of M&V is to verify that the predicted and contractually specified energy savings are being achieved and, if necessary, to account for any changes to an energy retrofit that are outside of the control of the ESCO. The operation of equipment, both before and after a retrofit, can be measured with varying degrees of accuracy. Energy savings are a reduction in energy use and are the calculated difference between the measured operation of an EEM and the

amount of energy the system/building would have used without the retrofit. The M&V record provides long term documentation of the energy performing system's operation and is used to verify the long-term energy savings. The determination of savings requires three things:

1) Measurements of the energy-using system **operation** before and after a retrofit;

2) A contractual agreement as to how the energy retrofit equipment will be operated over time, and how the **performance** will be verified; and,

3) The **baseline model** - The baseline energy usage created using measured equipment operating data prior to the retrofit projected with assumptions about how the equipment will operate in the post-installation period.

In order to generate "savings" either the **performance** or the **operation** of an energy-using system must be changed. Savings are always defined in relationship to the **baseline model** for the particular time period under consideration. The ESCO is normally responsible for the performance of any equipment or systems installed under the energy performance contract. The contract will also specify the guaranteed energy savings for the project, and whether the ESCO or the Owner will be responsible for the operation of a particular piece of equipment. Changes in equipment operation result from factors that are within either party's control or outside either party's control. There are three categories of variables that account for the changes that might affect the performance of the retrofit. The categories and examples of changes that can occur are:

1) ESCO
   a) Equipment malfunction;
   b) Systems not installed properly;
   c) Systems not properly commissioned;
   d) Systems not engineered properly; or,
   e) Equipment not maintained in compliance with contract conditions.

2) OWNER

a) Changes in occupancy;

b) Changes in hours of operation;

c) Adding significant loads;

d) Does not determine effects of remodels on energy project; or,

e) Does not perform operation and maintenance procedures on existing and new equipment in accordance with contract requirements.

3) OTHER (VARIABLES OUTSIDE OF EITHER PARTY'S CONTROL)

a) Significant changes in weather conditions;

b) Changes in energy prices; or,

c) Natural disasters.

Defining "Savings"

As long as there have been energy efficiency projects, there have been efforts to quantify their effectiveness. Energy savings are not measured per se, since the absence of energy cannot be measured. However, the amount of energy a system/building uses and the service delivered by that system/building (lighting, heat, etc.), before and after the retrofit, can be measured and the performance of that system can be calculated.

In a performance contract, quantifying savings is normally a contractual requirement. However, savings determination procedures are complicated by a simple reality - the pre-retrofit performance and operating conditions must be known and projected onto the post-retrofit time period in order to determine what the energy consumption would have been without the retrofit. Only then can the savings be estimated. Once a building has been retrofitted, the opportunity to collect pre-retrofit performance and operating condition data is lost forever - it can never be determined exactly what would have happened without the retrofit.

In order to quantify savings from an energy efficiency project, measurements of building energy use, system performance and operating conditions are typically made before a retrofit (Baseline Energy Consumption) and after a retrofit (Post-Retrofit Energy Consumption) with necessary adjustments made for changes to the Baseline Model.

Energy Savings = Baseline Energy Consumption - Post-Retrofit Energy Consumption ± Changes to Baseline Model

The "before" measurement includes energy consumption, performance and operating conditions for the "pre-retrofit" time period and is used to define the baseline energy consumption or the "baseline model". The degree to which the baseline model continues to accurately represent how the system/building would have performed without the retrofit is directly related to the amount of non-retrofit-related changes taking place after the energy efficiency project is installed. Non-retrofit-related changes may include weather-related changes (milder or more severe weather patterns), occupancy changes, change in building use, change in building usage hours, change in performance due to general deterioration of systems, etc. Of particular concern, is the increasing "plug" load from personal computers, fans, air-conditioners, coffeepots, microwave ovens, refrigerators, etc. owned by building occupants. As such, the baseline model must be adjusted to take these changes into account. It is a basic goal of M&V to identify the factors that affect energy usage and create a baseline model that accounts for these factors.

The "post-retrofit" measurement includes measurement of the facility energy consumption, performance and operating conditions for a given "post-retrofit" period of time. What is measured and how it is analyzed for use in the savings calculations is specified by the project M&V plan, a plan which is agreed to by the Owner and the ESCO.

Every savings calculation contains assumptions. Some major assumptions used in savings calculations include how the baseline will be adjusted (e.g., if occupancy changes, what scaling factor will be used to modify the occupancy-related part of the energy

consumption), how the facility will be operated and maintained in order to achieve savings, who is responsible for the day-to-day operation and maintenance of the facility and equipment, how risk will be shared (e.g., if one of the parties is contractually responsible for operation and maintenance and does not operate and maintain the systems as contractually specified, how will that affect the savings calculations [upwards or downwards]?), etc. The M&V plan is the vehicle that can be used to specify the two parties' agreements regarding savings assumptions, methods to verify performance, calculate savings, and specify or list related contractual agreements.

International M&V Options

Performance contracting experts have been grappling with the problem of assessing savings for many years. The goal is to define methods and techniques that are fair and repeatable. While cognizant of the fact that all M&V methods need to be designed with a specific site in mind, experts have created standard protocols covering the full range of measurement possibilities and contractual situations. Three important efforts (IPMVP, FEMP and ASHRAE Guideline 14) have all come to similar conclusions regarding the best ways to categorize M&V procedures, or options. Table 1 – M&V Options and Implementation Costs provides a comparison of the important M&V options and implementation costs.

Readers interested in further information on the International Performance Measurement and Verification Protocol (IPMVP) can obtain materials from the Energy and Renewable Energy Clearinghouse (EREC) by calling (800) DOE-EREC or by visiting the IPMVP home page http://www.ipmvp.org.

Table 1: M&V Options and Implementation Costs

M&V Option	How Savings Are Calculated	Cost*
Option A: Focuses on physical assessment of equipment changes to ensure the installation is to specification. Key performance factors (e.g., lighting wattage or chiller efficiency) are determined with spot or short-term measurements and operational factors (e.g., lighting operating hours or cooling ton-hours) are stipulated based on analysis of historical data or spot/short-term measurements. Performance factors and proper operation are measured or checked annually.	Engineering calculations using spot or short-term measurements, computer simulations, and/or historical data in conjunction with Stipulated operational factors.	Dependent on number of measurement points. Approx. 1-3% of project construction cost.
Option B: Savings are determined after project completion by continuous measurements taken throughout the term of the contract at the device or system level. Both performance and operations factors are monitored.	Engineering calculations using metered data.	Dependent on number and type of systems measured and the term of analysis/metering. Typically 3-5% of project construction cost.
Option C: After project completion, savings are determined at the "whole-building" or facility level using current year and historical utility meter (gas or electricity) or sub-meter data.	Analysis of utility meter (or sub-meter) data using techniques from simple comparison to multivariate (hourly or monthly) regression analysis.	Dependent on number and complexity of parameters in analysis. Typically 2-5% of project construction cost.
Option D: Savings are determined through simulation of facility components and/or the whole facility. Option D is typically employed in new construction savings verification	Calibrated energy simulation/modeling; calibrated with hourly or monthly utility billing data and/or end-use metering.	Dependent on number and complexity of systems evaluated. Typically 0.25-1% of project construction cost.
(From IPMVP)		*Actual M&V implementation cost percentages will vary and may be less, based on the specific project and its complexity.

Issues Particular to Hawaii

The State of Hawaii Department of Business, Economic Development & Tourism (DBEDT) has been pursuing standard contract documents for its statewide performance contracting efforts. As a part of this effort DBEDT, co-sponsored two workshops on M&V. The first workshop was designed to introduce participants to M&V concepts in general, as defined in the IPMVP. The second workshop focused on the state's experience with real M&V plans that were used in state projects. Participants in the second workshop included personnel from the project sites and the ESCos. Issues pertaining to the fairness and completeness of M&V plans were discussed and solutions created. In the process of reviewing actual M&V plans for projects in the state of Hawaii, several major issues continued to surface as follows:

1) Importance of using common definitions;
2) Stipulated versus metered savings and their appropriate applications;
3) The difference between measuring energy savings and measuring cost savings;
4) How to determine the appropriate energy rate in calculating cost savings (average vs. marginal rate); the risks involved with using a fixed escalation rate for calculating cost savings; how to determine an appropriate level of M&V service and what that service should cost;
5) How to establish energy use baselines;
6) When and how to adjust energy baselines;
7) The importance of a clear and concise explanation of how savings will be calculated; theoretical versus "real world" applications of M&V; and,
8) The uncertainties and risks involved with monitoring and verifying energy savings.

Very few of the many specific M&V issues discussed resulted in any clear and final resolution. This is not surprising since most M&V issues are site and project specific. Many issues discussed were contract issues, rather than M&V issues. These contract

issues often determine the success of an M&V plan and, more importantly, the overall energy performance contract. Through facilitated discussion all parties agreed that better communication was needed on several core M&V areas. The following sections review those areas and provide suggestions for improvements.

The M&V Plan

Of all of the misconceptions surrounding the practice of M&V, none is more potentially dangerous than the belief that M&V procedures begin after the EEMs are installed. To be most effective, M&V activities need to be integrated into the entire project development cycle, from initial ESCO selection through final invoice. From the first moment that a facility is being considered as a possible retrofit site, data that are collected and analyzed can be useful later in the verification process. Opportunities are typically quantified early on in the project development process based on the age of the facility, the equipment that is in the facility, or the size of the energy bill relative to the facility square footage, function or some other benchmark. The initial M&V implementation activities include the definition of a general M&V approach and the requirement to develop a site-specific M&V Plan for the project. The steps for defining an M&V Plan include:

1) Identify goals and objectives;
2) Specify the characteristics of the facility and the EEM;
3) Specify the M&V Option, method and techniques to be used;
4) Specify data analyses procedures, algorithms, assumptions, data requirements, and data products;
5) Specify the metering points, period of metering and analyses and metering protocols;
6) Specify accuracy and quality assurance procedures;
7) Specify how results will be reported and documented;
8) Specify reporting period and report due date; and,
9) Define budget and resource requirements.

Every M&V Plan should strive for the greatest amount of certainty at the lowest cost. Because every building presents a different measurement problem, there is room for judgment and opinion as to the best M&V approach under any particular situation. It is primarily the responsibility of the ESCO to generate an initial M&V Plan that adequately supports the proposed M&V strategy, specifically addressing:

1) Issues of potential outside changes to the baseline (weather, production, occupancy);
2) Contractual allocation of performance and operational responsibility; and,
3) Building energy distribution (wiring & piping) characteristics relevant to metering activities.

The proper conduct of M&V strives to gather, store, validate and update assumptions about the conditions that offer retrofit opportunities. By preparing the M&V Plan early and revisiting the M&V agreements throughout the term of the project, the Owner and ESCO avoid potential misunderstandings about the assumptions that generate the baseline model.

The Energy Baseline

The energy baseline should be included in the M&V plan and presented in table form as an attachment to the contract. It may be appropriate to include a baseline for kWh, kW, and other forms of energy use. Equipment run time, equipment electrical loads, lighting "on time", boiler efficiency, steam use, condensate temperature, make-up water and facility operating hours are all parameters that can be quantified and which can be specific in the baseline.

It may be appropriate to periodically modify the Baseline. Suggested contract language for this modification is: "**The Baseline Energy Consumption, from which all future energy savings will be determined, may be modified to reflect changes in weather, operating hours, building modifications, added electrical loads or other**

facility changes which are not a result of the ESCO's modifications and which may result in an increase in electrical consumption. Any modification of the Baseline must be approved and agreed upon by the Owner."

Energy → Dollars

M&V accounts for the amount of energy saved and is the basis for what should be guaranteed in the contract. However, the ESCO or financier is paid in dollars - not kWh. Therefore, there is a need for a clear understanding of how kWhs, BTUs and other quantities of energy will be converted to dollars. Since energy accounting, by itself, provides many difficulties in arriving at a fair number for energy use, assigning a dollar amount brings in an entirely different set of complexities. For example, unit energy costs in Hawaii are often geared to the current price of fuel oil (via the fuel adjustment clause), constantly changing the dollar value of unit kWh savings. Furthermore, in an environment of potential deregulation there is reason to believe that energy price fluctuations and rate complexity will increase in variety. This will make it even more difficult to assign a dollar value to kW and kWh savings. Since public facilities normally pay for their energy costs out of an annual or biennial budget, the best approach to identifying the dollar value of the savings is to use the current rate schedule to calculate the cost savings. Then, the amount borrowed, interest rate, and repayment schedule is fixed between the Owner and ESCO or financier upon acceptance of the project. Ongoing M&V or maintenance costs can be pegged to future changes in the rates or rate structure. Given these considerations, the dollar value of an amount of energy savings is typically defined in the contract and the contract must address two issues in the assignment of dollar values:

1) The current rate structure of energy costs
2) Future changes in rates or rate structure

Rate Structures

The rate structure is determined by the servicing utility. A complete description of rate structures is beyond the scope of this chapter. In general, utility rates have the following components. For electricity - components include time of day, time of year, KVAR charges, kWh charges and kW demand charges. For synthetic natural gas there is a charge for the energy and sometimes there is a demand charge.

In order to understand the dollar value of a given EEM's electrical savings, one must know how and when the EEM operates and how it impacts total kWh, kW demand, KVAR, and any other charges that are assessed in the bill. Over-reliance on blended rates (a $/kWh rate that results from dividing the total kWh usage by the total bill, masking demand, kW charges and power factor, KVAR charges) may over or under estimate the dollar value of retrofit savings. Assumptions should be clearly defined. For example, one ESCO used blended rates to estimate potential savings, but actual rates to calculate them. It is always in both parties' interest to document and understand the rate structure and consider all its parts when determining savings.

Changes in Rates or Rate Structure

It is the responsibility of the Owner and the ESCO to arrive at a fair and equitable solution to valuing energy savings. The likelihood that the current rates and rate structure will be in place for the term of the contract is practically nil. Assuming that rates will change is probably always safe. However, future price fluctuations do not impact current or future energy savings. If an EEM saves 100,000 kWh per year at $0.10 per kWh then $10,000 a year will not be spent on the purchase of energy. If this is sufficient to pay off the financing over an agreed upon period of time, and the annual M&V costs, then there is enough savings to pay the loan no matter what happens to the cost of energy. The only impact of changes in energy rates is on the costs that are paid for future energy usage. Thus, in reality, future price fluctuations do not impact current or future energy savings;

they only affect future energy costs. If the guaranteed energy savings are achieved, there is no need to "correct" for changes to utility rates or rate structure.

Future maintenance costs, service costs, and M&V costs will, however, increase due to inflation and wage increases. The Owner and the ESCO need to agree contractually on how to address future changes to these costs. The contractual options include, but are not limited to:

1) Fixing rates for the term of the contract
2) Allowing for a pre-defined escalation factor
3) Allowing rates to "float"
4) Allowing rates to "float" between a floor and a cap
5) Defining rates based on threshold "the lesser of ..."

The option chosen should be fair to the ESCO and yet provide that the total annual costs remain less than the annual savings. Option 4) or 5) may provide the appropriate flexibility and control.

Savings Guarantee

A guarantee of energy savings and not energy cost savings should be included in the contract. Energy cost savings should be calculated using the cost of energy in the Base Year. Suggested contract language is: **"Energy savings are determined by multiplying the energy saved during year by the actual energy rate that prevailed at the time the Baseline was established."** Alternate language is: **"The unit energy cost used to calculate the energy cost savings shall be the Baseline energy unit cost."**

In the event that the contractually defined M&V procedures indicate that the retrofit has not provided the guaranteed performance and savings, the contract must provide instructions on how payments will be adjusted. In addition, in the case where energy savings are realized, but at the sacrifice of contractually defined standards of service, the contract must determine how the payment to the ESCO will be reduced and/or the ESCO will pay penalties to the Owner.

Sample contract language is: **"If the energy savings in any one year of the Contract, as reported in the annual Reconciliation of Energy Savings Report, are less than the annual guaranteed savings for that year, the ESCO shall pay the Owner the difference within thirty calendar days of issuing the report."**

In addition, **"Excess savings in any one year shall not be credited toward the annual guaranteed savings in any future year of the Contract."**

THE FOLLOWING LANGUAGE OR ANY VERSION THEREOF SHOULD NOT BE ACCEPTED: "In the event the annual energy savings in any one year exceeds the guarantee amount by ____%, the Owner and the ESCO will share the excess savings according to the following formula, etc."

Integrated Survey- Design -Audit/M&V Tools

M&V information does not exist separately from other project information. A proper M&V plan incorporates information that is gathered at other stages of project development. For instance, the information gathered for project screening and feasibility study should be very similar to the baseline.

Performance contracts are data-rich. In order to manage the information in a performance contract that all parties need to agree upon:

1) The types and level of data that will be required.
2) The schedule of data deliverables.
3) The formats for the data.
4) Tools that will be used to analyze the data (engineering and financial tools).

The best way to ensure that all of this data is handled efficiently is to create an integrated set of tools that can be used throughout the project lifetime.

Standard forms, presented in electronic spreadsheet format, are an effective tool for managing project data. Examples of analysis spreadsheets which have been developed for use in tracking and evaluating proposed energy savings performance contracts are

provided in Appendix III. Note that these spreadsheets can be used to develop customized spreadsheets to meet the needs of a specific organization or project. Electronic copies may be obtained from DBEDT's Energy, Resources, and Technology Division's website at www.hawaii.gov/dbedt/ert. These spreadsheet sets include:

1) Hawaii Energy Efficiency Measure Spreadsheets;
2) ESPC Workbook; and,
3) Scenario Evaluator (developed for the FEMP SuperESPC program).

Definitions

The following terms are common to M&V activities. Please note that these are general definitions and that both parties in a contract must agree on the final interpretation.

Baseline Usage or Demand -The calculated or measured energy usage (demand) by a piece of equipment or a site prior to the implementation of EEMs, systems, or products. Baseline physical conditions such as equipment counts, nameplate data, and control strategies will typically be determined through surveys, inspections, and/or metering at the site.

Benchmark - A benchmark is typically designed to provide relative performance information for similar facilities. For example, office buildings in Hawaii use x-xx kWh/sq.ft./year of electricity.

Calibrate - The methods used to assure, through checking and adjusting, that a model of energy use accurately predicts consumption.

Commissioning -The process for achieving, verifying and documenting the performance of EEMs to meet the operational needs of the Owner within the capabilities

of the design, and to meet the design documentation and the Owner's functional criteria, including preparation and training of operator personnel. Commissioning is the process of documenting design assumptions and design intent for use by contractors, owners and operators; functional performance testing and documentation necessary for EEM acceptance; and, adjusting the EEM to meet actual needs within the system's capabilities. Despite the obvious commonalities between commissioning and verification, there is no formal agreement on how these two disciplines overlap.

Demand Reduction Estimates - Energy demand reductions (e.g. in kW or Btu/hr) derived from metering and/or calculations in accordance with the provisions of the approved measurement and verification plans, and documented in regular true up or reconciliation reports.

Energy Savings Estimates - Energy savings (e.g. in kWh or Btus) derived from metering and/or calculations in accordance with the provisions of the approved measurement and verification plans, and documented in regular interval reports.

Facility Data and Information Package - Performance contracting requires gathering, storing, analyzing and retrieving facility, equipment, energy and cost information. The facility data and information package is the pre-defined format and location for this information. A properly constructed data package will contain all of the relevant technical and financial information in a performance contract. (See model Facility Data and Information Package at end of this Chapter.)

Measurement and Verification (M&V) - The process to verify the EEM's potential to generate savings and the measurement and documentation of performance, operation, and savings.

M&V Method - A generic, non-project-specific M&V approach that applies one of the four M&V Options to a specific EEM (Energy Efficiency Measure) technology

category. Examples of EEM categories are lighting efficiency retrofits and constant-load motor retrofits.

M&V Option - One of four generic M&V approaches (A, B, C and D) defined for performance contracting projects. These options are defined in the IPMVP. The Owner and ESCO should select the Option that provides the best definition of savings within the available budget.

Normalize - Energy using systems that vary relative to an independent variable can be measured in terms of that variable. Normalizing allows comparison relative to a common variable. For example, kWh/sq. ft, or BTU/ HDD.

Operation - Operation is the integration of performance characteristics over time, and may include how the system is operated, such as on/off, high/low, speed, etc.

Performance - Systems that use energy to deliver a service do so at some level of performance. Performance of the EEM includes an energy component (kW, BTU, Therm), and is normalized (e.g. watts/square foot or kW/ton). The performance after installation of an EEM can be compared to the baseline conditions to determine savings.

Performance and Operation - Energy using systems have instantaneous, measurable properties (operation) and time-dependent properties (operation, or performance over time).

Performance and Operation Responsibilities - In a performance contract, it is often necessary to divide usage in a way that addresses accountability. The ESCO is typically responsible for the performance; the Owner or the ESCO may be responsible for the operation and use.

Performance Factors - Factors that influence energy use (e.g. outdoor air temperature, lighting levels, and timeclock settings).

Performance Period - The time period from acceptance of the installation to the end of the project.

Performance Period Energy Use or Demand - The calculated energy usage (or demand) by a piece of equipment or a site after implementation of the project. The ESCO and the Owner verify post-installation energy use. They also verify that the proper equipment components or systems were installed, are operating correctly, and have the potential to generate the predicted savings.

Project - The implementation of energy efficiency services at a given facility or group of facilities.

Project Pre-Installation Report - Documentation that provides a description and inventory of existing and proposed energy-efficiency equipment, estimates of energy savings, and a site-specific M&V plan. Before the installation of energy-efficient equipment the ESCO provides pre-specified documentation that indicates the proposed equipment/systems, estimates associated energy savings, and defines operation and maintenance (O&M) procedures that ensure continued performance.

Project Post-Installation Report - Documentation that provides a description and inventory of old and installed energy-efficiency equipment, estimates of energy savings, and M&V results. After the installation of energy-efficient or other equipment, the ESCO provides pre-specified documentation that verifies the installed equipment / systems and associated energy savings and demonstrates proper commissioning that ensures the potential exists to generate the predicted savings.

Project-Specific M&V Plan - Plan providing details on how a specific project's savings will be verified based on the general M&V approaches contained in the IPMVP and the contract between the Owner and the ESCO.

Reconciliation (Regular Interval) Report - Pre-specified documentation provided by the ESCO at defined intervals (e.g. annually) during the performance period but after the first project post-installation report and issuance of the Certificate of Completion. This documentation verifies the continued operation of the installed equipment components or systems and the associated energy savings, demonstrates proper maintenance, and provides M&V results. The energy savings documented in the report serves as the basis for the ESCo's invoice after the regular interval report has been reviewed and approved by the Owner.

Savings Perceptions - The core concept of energy savings performance contracting is that a stream of dollar savings can be created and redirected to pay for an initial investment that creates the savings and pays for any ongoing maintenance or M&V costs. However, the major M&V protocols contain procedures that, when applied, could each give a different value for the amount of "savings" under the exact same scenario. This does not mean that M&V protocol has failed.

The participants in a performance contract must understand what "savings" means in the context of their contract, and be willing to accept the results of the savings determination process once it is under way. The participants should select the best option for the specific EEM that falls within the budget available. The alternative is to dispute every savings calculation, which is not preferred.

To a great extent, the practice of M&V involves gaining an understanding of the sensitivity of performance and operating variables and the likelihood of their remaining predictable for the term of a contract. With proper attention almost all contract contingencies can be foreseen and addressed without costly litigation.

Stipulate - Stipulate means to assign a value to a parameter in a savings calculation. The assigned value, or stipulated value, may result from: a) measurements taken during the baseline period and extrapolated for the term of the contract; or, b) engineering estimates. Performance contracts can make use of stipulations wherever the collection of operating data is cost-prohibitive or where the contract uses stipulated operation to address risk sharing.

For example: Under Option A of the IPMVP, savings are determined using a combination of measured data (typically based on operational factors) and stipulated data (typically based on operation schedules). Stipulations are used either to simplify the measurement process, to simplify the contracting process or both. Stipulations are not meant to be a complete replacement for measured data. Indeed, in most cases short term performance can be assessed and used to provide the basis for stipulated operation.

Risk Sharing - Contractual risk sharing may result when the building owner retains control of operational factors such as hours of operation of a lighting system. In these cases, an agreed-upon value for operating hours can be stipulated, and the resulting savings estimate used to calculate the amount of savings over the term of the contract.

Types of Loads- The type of energy consuming loads will dictate how the corresponding M&V procedure is specified. Types of loads include:

Constant - Little or no variation in energy usage.

Predictable - Energy usage varies in a way that can be explained by identifying a cause (driver) and the driver can be measured.

Random - Energy usage follows no discernible or predictable pattern. Efforts to identify "typical usage" during the baseline period are not advised.

Usage Group - A collection of equipment (e.g., motors or rooms with light fixtures) with similar characteristics (e.g., operating schedule).

Model Procurement Language

Rebuild America's "Model Procurement Documents: Energy Savings Performance Contracting [Guaranteed Energy Savings]" document set may be found at the Rebuild America web-site.

(http://www.eren.doe.gov/buildings/rebuild) The model documents are at: http://www.eren.doe.gov/buildings/rebuild/ca.docindex.info.frame.html (click on "Rebuild America" in the index) or at http://www.rebuild.org/sourcebook/ca.docindex.info.frame.html.

APPENDIX I

FACILITIES DATA REQUIREMENTS

APPENDIX I

STATE OF HAWAII
ENERGY PERFORMANCE CONTRACTING
PROJECT FEASIBILITY
FACILITIES DATA REQUIREMENTS

Department _____
Agency _____

Submit to Project Mgr:

_____
_____

Dept./Agency Contact Name and Address
_____
_____
_____

Phone _____FAX _____
E-mail:_____

Phone: _____
Fax: _____
E-mail _____

Project/Site Contact Name and Address
_____
_____
_____
_____

Phone _____FAX _____
E-mail:_____

Facility:
Owned Yes____No_____
Leased Yes ___ No _____
Remaining Term _____

1. Number of buildings at the site _____ Total Sq. Footage_____

2. Total annual energy bill. $_____ Mbtu_____
   a. Electricity $_____ kWh _____
   b. Other (Oil, steam, SNG) $_____ Btus _____

3. Identification of previous audit(s). Yes_____No_____
   a. Type _____
   b. Name of Firm_____ Date of audit _____
   c. Description of changes made to building as result of audit.
   _____

4. Identification of potential availability of funding, within the next two years, for energy efficiency retrofit projects. Yes_____ No_____

5. Is there a site energy management plan?_____ If so, attach a copy.

6. Description of methods used to track energy use and cost.
   _____

7. Description of metering set-up and method used to estimate individual building consumption? Direct metering _____ Other _____

8. Description of site technical expertise in building systems and energy management (check all that apply).

_____ Building/Facility Manager on site
_____ Energy manager on site.
_____ HVAC technician on site.
_____ Controls technician on site
_____ Electrician on site
_____ Engineering expertise on site on site.
_____ No technical staff on site.

9. Identification of mission or usage changes planned or anticipated in near future (up to five years) _____

_____

10. Identification of position and location of person managing utility budget:

_____

11. Utility bills are paid. Locally _____ Regionally _____ Nationally _____

12. Operations and Maintenance program.

    a. Description of the general maintenance practices and schedule for the building and its energy related systems. _____
       (attach additional pages if necessary)
    b. Description of any known maintenance problems and/or needs associated with deferred maintenance. _____

13. Identification of major challenges to the use of Performance Contracting for energy retrofit projects at this facility.

_____

_____

_____

Complete and Submit the Following Attachment for Each Building (or submit a matrix of all the information for multiple buildings)

Building Name and/or number: _____

Building Type and function:
(Choose from: hospital, housing multi, housing single, industrial, office, prison, school, Warehouse, laboratory)

Square Footage:_____ Number of Floors:

Age of Building:_____ Number of Occupants:_____ Occupied Hours:

Energy Sources	**Unit Cost**	**Annual Cost**	**12-Month consumption**	**Serving Utility**
Natural gas(**)_____				
Electricity (KWH)				
Oil (Gal)				
Purchased steam (Mlbs)				
Produced steam (Mlbs)				
Propane (Gal)				
Water (Gal)				
Other (specify)				

Are utility energy service (financing or incentive/rebate) programs available?

_____

Please check which of the following you can provide for this building:

____ Utility Rate Schedule
___ Historical utility bills
_____Up-to-date plans and as-built drawings
___ Equipment specifications
___ Equipment maintenance, service records, test reports, plant log data, combustion efficiency reports
___ Past surveys, energy or water audits, load profiles or utility studies (attach a copy of the executive summary)
___ Other (_____)
Comments:_____

General Information for Each Building
(Relevant Descriptions Which Could Aid in Project Data Development)

Building Construction
(Steel, Masonry, Wood frame, single or double glaze windows, insulated walls and roof, etc.)

Hot Water and Cooling Systems
(Hot water or steam boiler, forced air furnace, electric resistance, solar, etc.) (Central electric, absorption, or gas driven chillers, window units, rooftop packaged units, etc.)

Ventilation System
(Ducted single zone, multizone, VAV, dual duct system, through the wall ventilators, no ventilation, etc.)

Lighting Systems (fluorescent T12 or T8, ballast type, incandescent, controls)

Renewables in use (solar, wind, geothermal, etc.

Controls
(Ability to shut off equipment or setback temperatures when unoccupied, energy management system, etc.)

Hazardous materials present (asbestos, pcb ballasts, etc.)

Upgrades: What energy system upgrades, equipment changeouts, retrofits or other projects have been accomplished in this building in the last 3 years?

Other Relevant Information Relating to Building or Energy Use (historical preservation considerations, etc)

Attach a Simple Building or Site Floor Plan

APPENDIX II

IPMVP M&V GUIDELINES

Appendix II

MEASUREMENT & VERIFICATION GUIDELINES A GENERIC APPLICATION OF THE IPMVP

ACKNOWLEDGMENTS

Adapted by Cary Bullock from the
Guidelines for Energy Measurement & Verification for the Federal Energy Management Program
prepared by
Steven R. Schiller
Lorna D. Stucky and
David A. Jump
of Schiller Associates - Oakland, California.

●

This Appendix is a part of the
International Performance Measurement and Verification Protocol (IPMVP).
It is consistent with and references sections of the IPMVP which outline measurement and verification methods for a variety of projects.
The material contained herein was drawn from the ***Measurement and Verification (M&V) Guidelines for Federal Energy Projects,*** which was in turn developed in conjunction with the North American Energy Measurement and Verification Protocol.
Detailed descriptions of each method are contained in the ***Measurement and Verification (M&V) Guidelines for Federal Energy Projects*** (available on-line at http://eande.lbl.gov/CBS/femp/MVdoc.html).

PART 1: INTRODUCTION

This Appendix provides procedures and guidelines for quantifying savings resulting from the installation of ECMs under energy performance contracts and is intended to comply with the International Performance Measurement & Verification Protocols (IPMVP). The IPMVP was developed to provide a commonly accepted methodology for measuring energy savings associated with performance contracts. This Appendix is intended for general application in commercial, industrial, institutional and local public sector facilities.

1.1 PURPOSE AND SCOPE OF DOCUMENT

The purpose of this Appendix is to provide M&V guidelines that could be referenced along with the IPMVP in customer/building owner Requests for Proposals (RFPs) for seeking performance contractors and in performance contracts themselves.

1.1.1 General Approach To Measurement And Verification. There are two components of M&V for Energy Saving Performance Contracting (ESPC) projects:

- **Verifying ECM potential to perform and generate savings** - by confirming that: i) baseline conditions are accurately defined, and ii) the appropriate equipment components or systems are properly installed, performing per specification and have the potential to generate predicted savings.
- **Verifying ECM performance (savings)** - by determining the actual energy savings achieved by the installed ECM.

As the ESPC program is based on pay for performance, each ECM or site will have a site-specific verification process to determine its savings.

1.1.2 Level of Verification Effort and Definitions. Accuracy requirements for measuring and verifying savings is either defined by the customer's RFP or negotiated with the ESCO. The required level of M&V effort is then specified in the contract between the customer and ESCO. If any discrepancy arises between the definitions provided in IPMVP and the customer/ESCO contract, the definitions in the contract prevail.

PART 2: GENERAL M&V OVERVIEW

2.1 GENERAL APPROACH

The general approach to determining energy savings involves comparing the energy use associated with a facility, or certain systems within a facility, before installation of the ECM (baseline) and after installation of the ECM (post-installation). Therefore, in general:[1]

[1]Exceptions to this simple equation include new construction projects and projects in which baseline energy use is determined from similar facilities or from applicable new building performance standards, not from the facility where the retrofit actually occurred. Please see Section 6.0 of the IPMVP.

energy savings = (baseline energy use) - (post-installation energy use)

As ESPC projects are based on pay for performance, each ECM or site will have a site-specific verification process to determine its savings. For each site or project, the baseline and post-installation energy use will be defined using any or all of the following: metering, billing analysis and/or engineering calculations (possibly including computer simulation). In addition, values for certain factors that affect energy use and savings, *and that are beyond the control of the ESCO* (i.e., building occupancy), may be stipulated by the customer sponsoring the project.

After each project is completed, the ESCO submits a report that defines projected energy savings for the first year. This post-installation report must be accepted and approved by the customer. Typically, first year payments to the ESCO will be based on the projected savings values submitted in the report.

For the remaining years of the contract, the ESCO provides annual (or at some other regular interval) true-up reports. These reports include inspection documentation of the installed equipment/systems and (perhaps) updated savings values using data obtained and analyzed during each year of the contract. Previous payments would be reconciled as necessary based on the results of the periodic report. Each year, payments would be calculated based on information in the latest periodic report.

2.2 VERIFYING ECM POTENTIAL TO PERFORM

2.2.1 Maintaining Service Quality. The Demand Side Management (DSM) measures installed under ESPC programs should maintain or improve the quality of service provided to the customer by the affected equipment or systems. For example, lighting projects that reduce lighting levels must maintain some minimum standards, i.e., the minimum standard for the facility's primary use. This Appendix, however, does not address verifying performance standards. Specific facility performance requirements are defined in the solicitations/RFPs for ESCO services.

2.2.2 Baseline Verification. Baseline conditions may be defined by either the customer or the ESCO. If the baseline is customer-defined, then the ESCO will have the opportunity to verify it. If the baseline is defined by the ESCO, the customer will verify it. Baseline physical conditions such as equipment counts, nameplate data, energy consumption rate and control strategies will typically be determined through surveys, inspections and/or spot or short-term metering activities. Variables which affect baseline energy calculations such as weather and building occupancy are identified.

2.2.3 Post-Installation Verification. In a post-installation M&V verification, the ESCO and customer agree that the proper equipment components or systems were installed, are operating correctly and have the potential to generate the predicted savings. Verification methods may include surveys, inspections and/or continuous metering. The ESCO, or third party, is expected to complete the system/equipment commissioning. Current editions of ASHRAE's commissioning guideline GPC-1[2] can be the basis for commissioning activities.

[2] *Guidelines for Commissioning of HVAC Systems*, ASHRAE Guideline 1 (1989).

2.2.4 Regular Interval Post-Installation Verification. The ESCO and customer, at defined intervals during the term of the contract, will verify that the installed equipment components or systems have been properly maintained, continue to operate correctly and generate savings.

2.3 VERIFYING ECM PERFORMANCE

Either after the ECM is installed, continuously or at regular intervals, the ESCO and customer will determine energy savings in accordance with an agreed-upon M&V method using verification techniques defined in a site-specific M&V plan.

2.3.1 Verification Techniques. Baseline energy use, post-installation energy use and energy (and cost) savings will be determined using one or more of the following M&V techniques:

- Engineering Calculations
- Metering And Monitoring
- Utility Meter Billing Analysis
- Computer Simulations (e.g., DOE-2 Analysis)
- Mathematical Models (e.g., Regression Formulas)
- Agreed-Upon Stipulations By The Customer And The ESCO

2.3.2 Estimating Energy Savings. There are numerous factors that can affect energy savings during the term of a contract such as weather, operating hours, process loads and heat exchanger fouling. In general, one ESPC contract objective may be to adjust baseline energy use up or down for factors beyond the control of the ESCO (e.g., changes in building occupancy or weather), and adjust post-installation energy use for ESCO-controlled factors (e.g., maintenance of equipment efficiency).

In order to calculate energy savings, the customer may in some cases stipulate the value of factors that are difficult to determine or that may vary during the contract term. For example, in a lighting project the customer (or ESCO) measures the baseline and post-installation lighting fixture power draw and then stipulates the operating hours of the facility. For a chiller replacement project, the customer measures the baseline and post-installation chiller performance factors (e.g., IPLV kW/ton) and then stipulates the ton-hours of cooling at the facility in order to calculate annual energy savings. Stipulated values need to be checked for reasonable accuracy through comparisons between: i) total predicted savings against utility energy consumption data, and/or ii) values of actual conditions observed during site inspections. These are Option A techniques to measure and verify energy savings.

In other situations, continuous or regular interval measurements throughout the term of the contract may be compared to baseline energy measurements to determine savings. For a constant speed motor to variable speed drive motor conversion project, post-installation motor energy use may be continuously metered and compared against baseline measurements of motor energy use. These are Option B techniques to measure and verify energy savings.

There are many factors that affect energy consumption and various methods for estimating savings. A sampling of typical methods is contained in parts 2, 3 and 4 of this Appendix.

2.4 FACTORS AFFECTING APPROPRIATE LEVEL OF M&V

The level of certainty required for verifying ECM potential to perform (generate savings) and performance (actual savings) will vary from project to project. The necessary confidence level used for establishing savings is a function of the value of the project and cost-effectiveness of the level of M&V sophistication. Factors that will affect the level of effort and cost (how much the effort costs), include the following:[3]

- Value Of ECM In Terms Of Projected Savings
- Complexity Of ECM And M&V Procedures
- Number Of ECMs At A Single Facility And The Degree To Which Their Savings Are Interrelated
- Number Of Interrelated ECMs At A Single Facility
- Uncertainty Of Savings
- Risk Allocation Between The ESCO And The Customer For Achieving Savings
- Other Uses For M&V Data And Systems

Factors that typically affect M&V accuracy and costs are as follows (some of these are interrelated):

- Level Of Detail And Effort Associated With Verifying Baseline And Post-Installation Surveys
- Sample Sizes (Number Of Data Points) Used For Metering Representative Equipment
- Duration And Accuracy Of Metering Activities
- Number And Complexity Of Dependent And Independent Variables Which Are Metered Or Accounted For In Analyses
- Availability Of Existing Data Collecting Systems, e.g., Energy Management Systems
- Contract Term
- Confidence And Precision Levels Specified For Energy Savings Analyses

Discussion and definition of site-specific M&V plans should include consideration of accuracy requirements for M&V activities and the importance of relating M&V costs and accuracy to the value of the ECM savings. For certain types of projects, a statistical definition of accuracy could be included in a contract. For other types of projects, it may be possible only to define a subjective accuracy range or percent of payment budget for M&V. For each M&V method discussed in Section 3 of the IPMVP and throughout this Appendix, varying levels of effort and accuracy can be defined.

2.5 METERING AND MONITORING PROTOCOLS

A site-specific M&V plan should demonstrate that any metering and monitoring will be done in a consistent and logical manner. Metering and monitoring reports must address exactly what was measured, how, when, by whom and with what kind of meter it was measured. Calibration is

[3]These factors are discussed in more detail in Part 4 of this Appendix.

required. Readers may wish to view the sample forms in the FEMP Guidelines. These forms are not required, but they give an indication of the level of detail typically required. Both raw and completed data should be submitted to the customer with post-installation and regular interval reports.

The duration of metering and monitoring must be sufficient to ensure an accurate representation of the amount of energy used by the affected equipment both before and after project installation. The measurements should be taken at typical system outputs within a specified time period, such as one month. These measurements can then be extrapolated to determine annual and time-of-use period energy consumption.

The required length of the metering period depends on the type of project. If, for instance, the project is a system that operates according to a well-defined schedule under a constant load, such as a constant-speed exhaust fan motor, the period required to determine annual savings could be quite short. In this case, short-term energy savings can be easily extrapolated to the entire year.

If the project's energy use varies both across the day and seasons, as with air-conditioning equipment, however, a much longer metering or monitoring period may be required to characterize the system. In this case, long-term data or a model correlated to short-term data are used to determine annual and time-of-use period energy savings.

For some types of projects, there may be uncertainty as to how long the metering must be conducted. For example, there is still controversy over how long lighting operating hours must be measured in office buildings to determine a representative indication of annual operating hours. In these situations, a discussion is required between project participants to determine the appropriate answer for the ECM under consideration.

If the energy consumption of the metered equipment or systems varies by more than ten percent from month to month, sufficient measurements should be taken to account for these variances. Any major energy consumption variances due to seasonal activity or periodic fluctuations should also be monitored. If these variances cannot be monitored for whatever reason, they must be built into the annual energy consumption figure through an agreed-upon adjustment.

Extrapolation can take the form of measuring and normalizing energy consumption as a function of some independent parameter, such as ambient temperature, humidity or percent occupancy of a building. Once the relationship between equipment energy consumption and the parameter(s) are established, then extrapolation can be done by extending the relationship over a one year period. Therefore, the site-specific M&V plan should identify critical variables, explain how they will be measured or documented and discuss how they will be used in the extrapolation. The assumptions and mathematical formulas that are used in the M&V plan must be clearly stated. Any auxiliary energy-consuming equipment must be metered or accounted for if its energy consumption changes as a result of the project installation.

2.6 ENERGY COSTS

The ultimate goal of an ESPC is to reduce energy costs at customer facilities. The IPMVP is designed to provide energy savings information in such a way that cost savings can be estimated.

Energy cost savings may be calculated using energy savings and the appropriate cost-per-unit of energy saved. In most cases, the unit cost of energy will be based on a servicing utility's energy rate schedules at the time the project is implemented. The unit cost of energy that will be used in calculating energy cost savings must be defined in sufficient detail in the contract to allow calculation of savings using each of the factors that affect cost savings. These factors include items such as (for electric bills) kWh saved, kW saved, power factor, kW ratchets and energy rate tiers.

For performance contracts based on energy cost savings, an M&V method will need to be selected that provides energy savings data by time-of-use periods of the facility's rate structure. For example, at a prison the water heating peak load 252 kW over a two-minute averaging period, 228 kW over 15 minutes, or 192 kW using 60-minute time periods of analysis. Considerable error in cost savings estimates are introduced by data that does not correspond to the rate structure (15 minutes, in this case). Thus, it is critical that M&V plans should be able to reflect the effects of time-of-use and block rate schedules.

2.7 STANDARDIZED FORMS

Equipment surveys submitted by ESCOs are expected to be comprehensive, accurate (±5%) and current (completed within a reasonable time before submittal). Data and surveys submitted should be provided in both electronic and hard copy formats as specified by the customer. Sample survey forms for lighting and motors projects can be found in the appendices of the FEMP Guidelines.

2.8 INSPECTIONS

Pre-installation, post-installation and regular interval inspections (e.g., annual) by customer representatives may be conducted to confirm documentation submitted to the customer by the ESCO. These inspections, or confirmation visits, by customer representatives are important. If the customer believes conditions at the site are not accurately represented by the documentation, the ESCO may be allowed the opportunity to address the problem and re-submit the information.

2.9 INTERACTIVE EFFECTS

It is commonly understood that various ECMs interact with each other. Reduced lighting loads, for example, can reduce air conditioning energy consumption, but increase heating consumption. However, the detailed relationship between most dissimilar, but interactive ECMs is not known, and the methods for measuring interactive effects are not cost-effective for many applications.

For lighting projects, three approaches to account for savings associated with interactive effects include the following:

1. Ignore interactive effects.
2. Use mutually agreed-upon default values that are applicable based on the site-specifics associated with building type and HVAC equipment type. The default values can be assigned based on either available information for typical buildings, or developed based on computer model simulation for typical building conditions. A critical element of this approach is for the ESCO or customer to demonstrate in the baseline lighting survey that the measures are in air-

conditioned space. If the space is also heated, post-installation energy consumption needs to be adjusted upward to account for heating load increases caused by losses in internal heat gains from efficient lighting equipment.

3. Propose a method to measure and estimate interactive effects. The customer and/or ESCO will need to agree on the merit and reasonableness of the proposed approach that may include: i) directly measuring, ii) simulating the HVAC (heating and cooling) interactive effects using a fully-documented computer program, or iii) using a utility meter billing analysis approach that captures interactive effects in the total predicted savings. All methods need to be proposed and reviewed on a site-specific basis.

PART 3: M&V METHODS

3.1 M&V METHODS BY ECM

ECMs covered in this section are the most common types currently being implemented though performance contracts, including:

- lighting efficiency retrofit projects and constant load motor retrofit projects that are representative of constant load, constant operating hours projects.
- lighting controls retrofit projects that are representative of constant load, variable operating hours projects.
- variable speed drive retrofits and chiller replacement projects that are representative of variable load, variable operating hour projects.

Generic variable load, variable operating hours, utility billing analysis and computer simulation M&V methods are also presented.

Table 1 presents a summary of 24 methods that have been defined for different ECM categories (these are representative of most anticipated situations). Detailed descriptions of each method are contained in the *Measurement and Verification (M&V) Guidelines for Federal Energy Projects.*

Tables 2-6 provide summary points regarding M&V methods by end-use technology:

- *Table 2 - Lighting Efficiency Retrofits*
- *Table 3 - Lighting Controls Retrofits*
- *Table 4 - Constant Load Motor Retrofits*
- *Table 5 - VSD Retrofits*
- *Table 6 - Chiller Retrofit Projects*

The measure codes (XX-Y-Z) in the tables below use the following format:

- *XX - Refers To The Technology*
- *Y- Denotes Option A, B Or C*
- *Z – Refers To The Specific Approach*

Note that Option D methods are not included in the tables below, because at the time of printing, FEMP Guidelines had not been updated to include Option D.

Table 1: Summary of M&V Methods by Technology and M&V Approach

Method & Reference	Technology	Option	Approach
LE-A-01, Chapter 5	Lighting Efficiency	Option A	No metering
LE-A-02, Chapter 5	Lighting Efficiency	Option A	Spot metering of fixture wattage
LE-B-01, Chapter 10	Lighting Efficiency	Option B	Continuous metering of operating hours
LE-B-02, Chapter 11	Lighting Efficiency	Option B	Continuous metering of lighting circuits
LE-C-01, Chapter 18	Lighting Efficiency	Option C	Utility billing analysis
LC-A-01, Chapter 6	Lighting Controls	Option A	No metering
LC-A-02, Chapter 6	Lighting Controls	Option A	Spot metering of fixture wattages
LC-B-01, Chapter 12	Lighting Controls	Option B	Continuous metering of operating hours
LC-B-02, Chapter 13	Lighting Controls	Option B	Continuous metering of lighting circuits
CLM-A-01, Chapter 7	Constant Load Motors	Option A	Spot metering of motor kW
CLM-B-01, Chapter 14	Constant Load Motors	Option B	Continuous metering of motor kW
CLM-C-01, Chapter 18	Constant Load Motors	Option C	Utility billing analysis
VSD-A-01, Chapter 8	VSD Retrofit	Option A	Spot metering of motor kW
VSD-B-01, Chapter 15	VSD Retrofit	Option B	Continuous metering of motor kW, speed frequency, or controlling variables
VSD-C-01, Chapter 18	VSD Retrofit	Option C	Utility billing analysis
CH-A-01, Chapter 9	Chiller Retrofit	Option A	No metering
CH-A-02, Chapter 9	Chiller Retrofit	Option A	Verification of chiller kW/ton
CH-B-01, Chapter 16	Chiller Retrofit	Option B	Continuous metering of new chiller
CH-B-02, Chapter 16	Chiller Retrofit	Option B	Continuous metering of new chiller and cooling load
CH-C-01, Chapter 18	Chiller Retrofit	Option C	Utility billing analysis
CH-C-02, Chapter 19	Chiller Retrofit	Option C	Computer simulation
GVL-B-01, Chapter 17	Generic Variable Load Project	Option B	Continuous metering of end-use energy use
GVL-C-01, Chapter 18	Generic Variable Load Project	Option C	Utility billing analysis
GVL-C-02, Chapter 19	Generic Variable Load Project	Option C	Computer simulation

Table 2: Lighting Efficiency Retrofits - M&V Methods

M&V Method	**Method LE-A-01: No Metering**	**Method LE-A-02: Metering of Fixture Wattages**	**Method LE-B-01: Metering of Operating Hours**	**Method LE-B-02: Metering of Lighting Circuits**	**Method LE-C-01: Utility Billing Analysis**
M&V Option	Option A	Option A	Option B	Option B	Option C
Fixture Counts	survey which is checked to defined accuracy	same as LE-A-01	same as LE-A-01	same as LE-A-01	same as LE-A-01
Fixture Wattages	fixture wattage table or manufacturer data	one time (before and after) measurements of representative fixture wattages	fixture wattage table or fixture measurements	measured circuit wattage	required - as a check, and for future baseline modifications
Pre-Installation Operating Hours	a) stipulated based on estimates, or b) stipulated based on some short-term pre-monitoring	same as LE-A-01	assumed equal to post-installation hours which are monitored	same as LE-B-01	not required - unless as a check, or for future baseline modifications
Post-Installation Operating Hours	same as pre-installation operating hours	same as LE-A-01	monitoring of operating hours	measurement of circuit average power draw implies operating hours	not required - unless as a check
Interactive Factors	a) not allowed, or b) stipulated percentage, or c) based on simulation	same as LE-A-01	same as LE-A-01	same as LE-A-01	Included in billing analysis results

Table 3: Lighting Controls Retrofits - M&V Methods

M&V Method	**Method LC-A-01: No Metering**	**Method LC-A-02: Metering of Fixture Wattages**	**Method LC-B-01: Metering of Operating Hours**	**Method LC-B-02: Metering Lighting Circuits**
M&V Option	Option A	Option A	Option B	Option B
Fixture Counts	survey which is checked to defined accuracy	same as LC-A-01	same as LC-A-01	same as LC-A-01
Fixture Wattages	fixture wattage table or manufacturer data	one time measurements of representative fixture wattages	fixture wattage table or one time fixture measurements	measured circuit wattage
Pre-installation Operating Hours	a) stipulated based on estimates, or b) stipulated based on some short-term pre- monitoring	same as LC-A-01	operating hours are monitored for representative sample(s) of fixtures	the circuit measurement of average power draw also provides operating hours
Post-installation Operating Hours	a) stipulated based on estimates, or b) stipulated based on some short-term post-monitoring	same as LC-A-01	operating hours are monitored for representative sample(s) of fixtures	the circuit measurement of average power draw also provides operating hours
Interactive Factors	a) not allowed, or b) stipulated percentage, or c) based on simulation	same as LC-A-01	same as LC-A-01	same as LC-A-01

Table 4: Constant Load Motor Retrofits - M&V Methods

M&V Method	**Method CLM-A-01: Metering of Motor kW**	**Method CLM-B-01: Metering of Operating Hours**	**Method CLM-C-01: Utility Billing Analysis**
M&V Option	Option A	Option B	Option C
Motor Counts	survey which is checked to defined accuracy	same as CLM-A-01	same as CLM-A-01
Baseline and Post-Installation Motor Power Draw	spot wattage/rpm measurements	spot and short-term wattage/rpm measurements	not required - unless as a check or for future baseline modifications
Pre-installation Operating Hours	a) stipulated based on estimates, or b) stipulated based on some short-term pre-monitoring	assumed equal to post-installation hours which are monitored	not required - unless as a check or for future baseline modifications
Post-installation Operating Hours	same as pre-installation operating hours	monitoring of operating hours or kWh	not required - unless as a check
Confirmation of Constant Load	a) stipulated, or b) short-term metering of sample of motors	same as CLM-A-01	not required - unless as a check

Table 5: Variable Speed Drive Retrofits - M&V Methods

M&V Method	**Method VSD-A-01: Metering of Motor kW**	**Method VSD-B-01: Continuous Metering of Motor kW or Controlling Variables**	**Method VSD-C-01: Utility Billing Analysis**
M&V Option	Option A	Option B	Option C
Inventory of Motors and Drives/Controls	survey which is checked to defined accuracy	same as VSD-A-01	same as VSD-A-01
Verification of System Operation	functional verification of VSD operation	same as VSD-A-01	same as VSD-A-01
Baseline Motor Power Draw At Different Operating Conditions	stipulated based on a) spot or short-term wattage/rpm measurements (baseline is constant load), or b) short-term wattage/input measurements (baseline is variable load)	a) spot or short-term wattage/rpm measurements (baseline is constant load), or b) short-term wattage/input measurements (baseline is variable load)	not required - unless as a check or for future baseline modifications
Baseline Operating Hours[4]	stipulated based on estimates or some short-term pre-monitoring	a) assumed equal to post-installation conditions - which are monitored, or b) if variable, then long-term pre-monitoring	not required - unless as a check, or for future baseline modification
Baseline[5] **Operating Conditions - Independent Variables That Impact Energy Use, Operating Hours e.g. weather**	not used for method	assumed equal to post-installation conditions - which are monitored	not required - unless as a check, or for future baseline modifications
Post Installation[6] **Motor Power Draw at different operating (input) conditions**	a) stipulated based on manufacturer data, or b) spot or short-term wattage/ rpm measurements	continuous or regular interval wattage measurements	not required
Post-Installation[7] **Operating Conditions - Independent Variables That Impact Energy Use**	not used for method	long-term post-monitoring for input into post- and pre-installation model	not required

[4]With some VSD projects the replaced motors are always at constant load so that the baseline energy use is equal to the product of motor kW and motor operating hours.
[5]With some VSD projects the replaced motors have variable loading depending on the independent factors such as weather which impact valve or damper positions.
[6]Post-installation energy use can be directly measured.
[7]Post-installation energy use can be calculated based on measurement of independent variables, e.g. ,weather, once a correlation has been established between post-installation energy use and the independent variable.

Table 6: Chiller Retrofit - M&V Methods, Page 1 of 2

M&V Method	**Method CH-A-01: No Metering**	**Method CH-A-02: Verification of Chiller kW/ton Ratings**	**Method CH-B-01: Continuous Metering of Chiller (post-installation)**
M&V Option	Option A	Option A	Option B
Inventory Of Chillers And Auxiliary Equipment	survey which is checked to defined accuracy	same as CH-A-01	same as CH-A-01
Verification Of System Operation	functional verification of chiller system operation	same as CH-A-01	same as CH-A-01
Baseline Chiller And Auxiliary Equipment Power Draw (At Different Cooling Loads)	stipulated based on manufacturer data and/or other sources	a) stipulated, or b) spot or short-term kW/cooling load measurements to determine performance curve or kW vs. cooling load	same as CH-A-02
Baseline Cooling Load (Stated In Average Ton Hours Per Year Or Percent Time At Different Cooling Loads)	stipulated based on estimates e.g., computer model simulation	same as CH-A-02	a) stipulated, or b) assumed equal to post-installation cooling load which is determined from measurement of new chiller kW and use of new chiller performance curve
Post-Installation Chiller And Auxiliary Equipment Power Draw (At Different Cooling Loads)	stipulated based on manufacturer data, and/or other sources	a) stipulated, or b) spot or short-term kW/cooling load measurements to determine performance curve or kW vs. cooling load	continuous or regular interval metering of chiller kW to determine post-installation energy use
Post-Installation Cooling Load (Stated In Average Ton Hours Per Year Or Percent Time At Different Cooling Loads)	stipulated based on estimates	same as CH-A-01	not required for this method

Table 6 Continued, Page 2 of 2

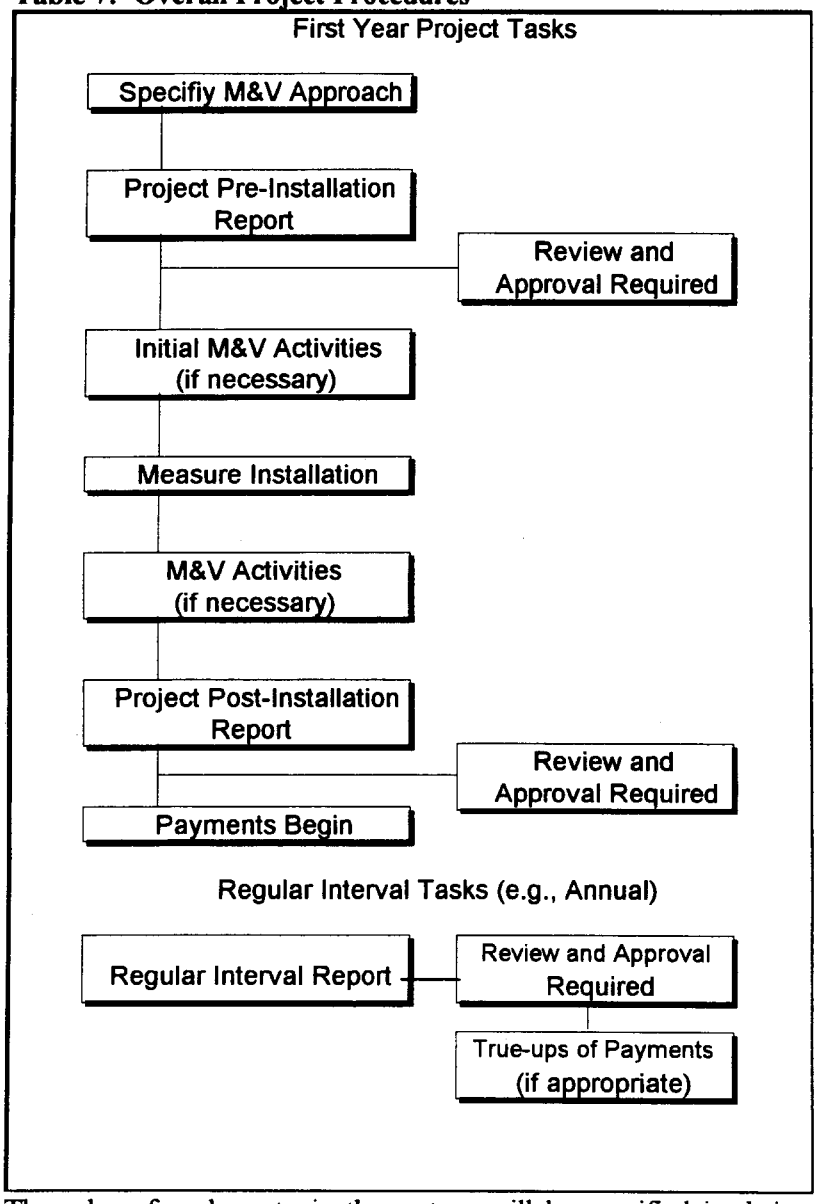
M&V Method	**Method CH-B-02: Continuous Metering Of Chiller And Cooling Load (Post-Installation)**	**Method CH-C-01: Utility Billing Analysis**	**Method CH-C-02: Computer Simulation Calibrated To Whole Building Utility Data**
M&V Option	Option B	Option C	Option C
Inventory Of Chillers And Auxiliary Equipment	same as CH-A-01	same as CH-A-01	same as CH-A-01
Verification Of System Operation	same as CH-A-01	same as CH-A-01	same as CH-A-01
Baseline Chiller And Auxiliary Equipment Power Draw (At Different Cooling Loads)	same as CH-A-02	not required - unless as a check, or for future baseline modifications	use of: (a) typical data, (b) manufacturer data, or (c) spot or short-term wattage/cooling load measurements to determine performance curve
Baseline Cooling Load (Stated In Average Ton Hours Per Year Or Percent Time At Different Cooling Loads)	assumed equal to post-installation load which is continuously measured	not required - unless as a check, or for future baseline modifications	determined with computer simulation with possible calibration check against utility metering or end-use metering
Post-Installation Chiller And Auxiliary Equipment Power Draw (At Different Cooling Loads)	same as CH-B-01	not required - unless as a check	use of: (a) typical data, (b) manufacturer data, or (c) spot or short-term wattage/cooling load measurements to determine performance curve
Post-Installation Cooling Load (Stated In Average Ton Hours Per Year Or Percent Time At Different Cooling Loads)	post-installation cooling load is determined from measurement of water or air flows and temperatures	not required - unless as a check	determined with computer simulation with possible calibration check against utility metering or end-use metering

PART 4: OVERVIEW OF GENERAL PROCEDURAL STEPS AND SUBMITTALS

4.1 M&V ACTIVITY DETAILS

As a contract is implemented, both the customer and ESCO take certain steps with respect to the M&V of each project. Table 7 presents a flow chart of the steps.

Table 7: Overall Project Procedures



The roles of each party in these steps will be specified in their contract depending on type of specific business agreements, risk allocation and accuracy of desired verification. In general, the

ESCO will provide documentation on equipment and demonstrated savings. The customer will verify submittals for accuracy and provide approval before the project can proceed to the next step. The submittals include a: i) Project Pre-Installation Report, ii) Project Post-Installation Report, and iii) Regular Interval Reports. As part of the review of the submittals, the customer may conduct site inspections to confirm submittal data.

It should be noted that these steps should be applicable to most projects, however, some M&V activities (outlined below) might not be necessary if certain variables in estimating savings are stipulated in the contract. The steps identified above are briefly described in the following paragraphs.

4.1.1 Site-Specific M&V Plan. A site-specific M&V plan that is based on the guidelines must be defined. The approach will also be based on the type of ECM and the desired confidence and accuracy of verification. In some cases, that plan will be included by the agency as part of the solicitation, in other cases the ESCO will propose a site-specific plan to be finalized after the awarding of the contract. The decision as to whether the agency will specify the site-specific plan or the contractor will be asked to provide one may be based on resources available to the agency when constructing the solicitation.

4.1.2 Project Pre-Installation Report. A Project Pre-Installation Report is generated for each project selected for installation. The report is generated by the ESCO. The customer must review and approve the report before the ESCO can proceed with the project. At its sole discretion, the customer may conduct site inspections to confirm submittal data. This report should include a project description, facility equipment inventories with recommended ECMs, energy and cost-savings estimates, cost-effectiveness calculations, a site-specific M&V plan, budget documentation (construction and M&V budgets) and proposed construction and M&V schedules.

4.1.3 Initial M&V Activities and Meter Installation. Once the customer accepts the Project Pre-Installation Report, metering (if necessary) and/or project installation may proceed. Pre-installation metering is conducted in accordance with the approved, site-specific M&V plan in the contract and/or the Project Pre-Installation Report. Metering is commissioned, and the customer may witness the calibration. When required pre-installation metering has been completed and accepted by the customer, the project can be installed. During metering and project installation by the ESCO, the customer may request progress reports or conduct inspections. Major tasks associated with M&V work prior to measure installation are as follows[8]:

- Pre-installation M&V activities are conducted, and the customer and the ESCO agree on an M&V plan, an inspection and an installation schedule based on contract terms.
- As identified in the contract and/or Project Pre-Installation Report, pre-installation metering is conducted for a period of time required to capture all operating conditions of affected systems and/or processes. If the ESCO is responsible for metering, the customer will conduct progress inspections (and/or reports), as required.
- The customer notifies the ESCO that project installation may begin. If no pre-installation M&V activities are required, project installation approval may be given upon acceptance of the Project Pre-Installation Report.

[8]If M&V work is not required prior to installation, the first two tasks are not required.

- Project installation begins.
- The ESCO notifies the customer that project installation is complete.

4.1.4 Project Post-Installation Report. When the measures are installed, the ESCO notifies the customer that project installation is complete by submitting the Project Post-Installation Report. This report includes baseline and post-installation calculations with energy and cost-savings estimates. Post-installation M&V work may be conducted prior to submitting a Project Post-Installation Report. The customer, as required, inspects the installed project and any post-installation metering. Major post-installation tasks associated with this submittal are as follows[9]:

- Post-installation M&V activities are scheduled to begin and, if conducted by the ESCO, coordinated with customer facility personnel.
- As identified in the contract and/or Project Pre-Installation Report, post-installation metering may be conducted by the ESCO for the period of time required to capture all operating conditions of the measure and/or impacted process. If applicable, customer facility personnel will conduct progress inspections of metering.
- Metering documentation for verification is included in the Project Pre-installation Report.
- A Project Post-Installation Report is generated. The customer may either approve if the project and documentation are acceptable or disapprove if the project and documentation are unacceptable or issues exist that prevent a review decision.
- Upon customer acceptance of the Project Post-Installation Report, ESCOs may submit invoices for first-year payment based on savings estimates in the accepted Project Post-Installation Report.

4.1.5 Regular Interval Reporting. Regular true-up M&V activities are conducted periodically based on contract terms between the customer and ESCO.

Periodic reports are generated that present energy and cost-savings. If the ESCO is responsible for metering, it analyzes current M&V data and submits periodic reports for customer review and approval. The periodic reports include measurement-based kWh savings data. Periodic report data is used for correcting, if necessary, the previous payments by the customer to the ESCO. These same data is also used for projecting energy savings for subsequent contract periods, and is the basis for contract payments in the following period. Major tasks associated with periodic reports are as follows:

- If the ESCO is responsible for metering, it notifies the customer that periodic true-up activities are scheduled to begin. Periodic true-up metering may be conducted for the period of time required to capture all operating conditions of the projects(s) and/or affected processes. The customer can conduct progress inspections of metering as required.
- M&V documentation is presented in Regular Interval Reports. Customer facility personnel review and approve these reports.
- Customer facility personnel ensure that the report and verification documentation are complete, accurate, and in compliance with the contract and approved site-specific M&V plan. Based on the results, payments during the previous period are reconciled and adjusted in subsequent

[9] If M&V work is not required prior to submittal of the Project Post-Installation Report, then the first three tasks are not required.

contract payments. This payment reconciliation would not apply if fixed payments are specified in the contract.

4.1.6 Payments. The project payment process is described below:

- The customer accepts both the Project Pre-Installation Report and Project Post-Installation Report.
- The terms and conditions of the customer-issued purchase order covers information which must be in the invoice. The amount of the invoice is also specified.
- The customer pays the ESCO upon approval of the invoice in accordance with contract terms and conditions.
- Some projects may be set up so that payments are based on results in the Regular Interval Report, which indicates verified energy and cost-savings results of the previous period.

Based on the contract, the customer may use the report to reconcile payments made to the ESCO for the previous billing periods, since previous payments were made based on estimated savings that now need to be reconciled to reflect actual savings. This payment reconciliation would not apply if fixed payments are specified in the contract. The estimates in the report may also be used as the basis for subsequent payments.

APPENDIX III

ANALYSIS SPREADSHEETS

Sample Analysis Spreadsheets

Following are hard copies of three separate analysis spreadsheets which have been developed for use in tracking and evaluating proposed energy savings performance contracts. These spreadsheets are provided for information purposes and the ideas included in the spreadsheets can be used to develop customized versions to meet the needs of a specific organization or project. Electronic versions are located on DBEDT's website at http://www.dbedt/ert.

The spreadsheet sets include:

1. Hawaii Energy Efficiency Measure Spreadsheets Tables 1-7 (developed based on Hawaii-specific forms).
2. ESPC Workbook (developed for federal ESPC projects)
3. Scenario Evaluator (developed for the FEMP SuperESPC Program).

1. Hawaii Energy Efficiency Measure Spreadsheets

Table 1
Energy Efficiency Measure Summary

Company Name: Acme ESCO
Building or Facility Name: Building1

(Aggregates data from summary sheets)

EEM No.	Energy Efficiency Measure (EEM)	Electricity Savings (kWh/yr)	Peak Demand Reduction (kW)	Fuel Savings (include units)	Energy Cost Savings ($/yr)	Estimated Measure Cost ($) from Table 2	Estimated Life of Measure (years)	Refer to Page(s)
1		1000			300	$ 48	10	
2		102000			10200	$ 48	10	
3		9			36	$ 48	10	
	TOTALS	103009	0	0	10536	$ 144	30	

Table 2
Summary Sheet for EEM Number 1

Building:	Building1
Name of EEM:	

1. DESCRIPTION (include quantities, types, sizes, locations, etc.)

a. Existing Conditions

Quantity	Type	Size	Location
1	y	12	

b. Proposed Conditions with EEM:

Quantity	Type	Size	Location
1	z	10	

2. NET FIRST YEAR ENERGY SAVINGS

Fuel Type (electric, gas, oil)	Fuel Units (kWh, Therms, KW, gallons)	First Year Fuel Savings (kWh, Therms, KW, gallons)	Unit Cost for the Fuel	Cost Savings
		1		$ 100
		1		$ 100
		1		$ 100
TOTALS		3		$ 300

3. Cost Estimate Summary of Measure

Materials	$ 12
Labor	$ 12
Contingency	$ 12
Other (Specify)	$ 12
Total	$ 48

4. Expected useful life: 10 years
5. The measure interacts with EEM No(s) (describe interaction)
6. The measure impacts EEM No(s) (describe impact)
7. Impact on standards of service and comfort. (describe)

Table 2
Summary Sheet for EEM Number 2

Building: Building1
Name of EEM:

1. DESCRIPTION (include quantities, types, sizes, locations, etc.)

a. Existing Conditions

Quantity	Type	Size	Location
1	y	12	

b. Proposed Conditions with EEM:

Quantity	Type	Size	Location
1	z	13	

2. NET FIRST YEAR ENERGY SAVINGS

Fuel Type (electric, gas, oil)	Fuel Units (KWh, Therms, KW, gallons)	First Year Fuel Savings (kWh, Therms, KW, gallons)	Unit Cost for the Fuel	Cost Savings
Electicity		1000	0.1	$ 100
Gas		1000	0.1	$ 100
Oil		100000	0.1	$ 10,000
TOTALS		102000		$ 10,200

3. Cost Estimate Summary of Measure

Materials	$ 12
Labor	$ 12
Contingency	$ 12
Other (Specify)	$ 12
Total	$ 48

4. Expected useful life: 10 years
5. The measure interacts with EEM No(s) (describe interaction)
6. The measure impacts EEM No(s) (describe impact)
7. Impact on standards of service and comfort. (describe)

Table 2
Summary Sheet for EEM Number 3

Building: Building1
Name of EEM:

1. DESCRIPTION (Include quantities, types, sizes, locations, etc.)
a. Existing Conditions

Quantity	Type	Size	Location
1	y	12	

b. Proposed Conditions with EEM:

Quantity	Type	Size	Location
12			

2. NET FIRST YEAR ENERGY SAVINGS

Fuel Type (electric, gas, oil)	Fuel Units (kWh, Therms, KW, gallons)	First Year Fuel Savings (kWh, Therms, KW, gallons)	Unit Cost for the Fuel	Cost Savings
		3		$ 12
		3		$ 12
		3		$ 12
TOTALS		9		$ 36

3. Cost Estimate Summary of Measure

Materials	$ 12
Labor	$ 12
Contingency	$ 12
Other (Specify)	$ 12
Total	$ 48

4. Expected useful life: 10 years
5. The measure interacts with EEM No(s) (describe interaction)
6. The measure impacts EEM No(s) (describe impact)
7. Impact on standards of service and comfort. (describe)

Table 3
Maintenance Services
(Contractor-installed, existing facility)

Building: Building1

EEM No.	EQUIPMENT	SCOPE	FREQUENCY	PARTY RESPONSIBLE (Contractor / Facility)

Table 4
Price Formula

For each item enter the proposed price as a lump sum and as a percentage of construction cost.

Energy Study Fee	$ 1,500			
Estimated Cost to Prepare Energy Study (if different from price above)	-NA-			
Design Services	$ 22	or	15%	of Construction Cost
Construction/Project Management Services	$ 23,500	or	15%	of Construction Cost
General Contractor Overhead and Profit	Overhead		15%	of Construction Cost
	Profit		155%	of Construction Cost
Commissioning and Initial Training	$ 12	or	155%	of Construction Cost
Interest During Construction	$ 12	or	12%	of Construction Cost
Bond Fees	$ 12	or	12%	of Construction Cost
Miscellaneous Fees	$ 12	or	122%	of Construction Cost
Term Financing Interest Rate	$ 12	or	8%	of Construction Cost
Monitoring and Verification	$ 12	or	12%	of Construction Cost
Maintenance Services	Overhead		122%	of Construction Cost
	Profit		1222%	of Construction Cost

Table 5
Calculation of Not To Exceed Project Cost
(Note: Include all components applicable to this project)

Not to Exceed (NTE) Installed Measure Cost	$ 144	From Table 4
Energy Study Cost	$ 1,500	
Design Services	$ 22	
Construction/Project Management Services	$ 23,500	
General Contractor Overhead and Profit	$ 245	
Commissioning and Initial Training	$ 12	
Interest During Construction	$ 12	
Bond Fees	$ 12	
Miscellaneous Fees and Permits	$ 12	
Project Development Fee	$ 22	2% of Installed Measure Cost
Other	$ 23,333	Specify
Pre-Tax Subtotal	$ 48,613	
Hawaii General Excise Tax	$ 5,369	11.00%
Other Taxes	$ 5,369	11.00%
Subtotal (NTE) Project	$ 59,552	
Less Utility Rebate	$ -	
TOTAL (NTE) Project	$ 59,552	

Table 6
Calculation of Cost Savings

Year	Annual Energy Cost Savings (from Table 1) (A)	Maintenance Cost Savings (B)	Other Cost Savings (C)	Gross Savings (D)=(A)+(B)+(C)	Total Payments (from Table 7) (E)	Net Savings (F)=(D)-(E)
1	10536			10536	0	10536
2				0	0	0
3				0	0	0
4				0	0	0
5				0	0	0
6				0	0	0
7				0	0	0
8				0	0	0
9				0	0	0
10				0	0	0
11				0	0	0
12				0	0	0
13				0	0	0
14				0	0	0
15				0	0	0
16				0	0	0
17				0	0	0
18				0	0	0
19				0	0	0
20				0	0	0
TOTAL	10536	0	0	10536	0	10536

Notes: Include utility rebates in "Other Cost Savings" if they will be included as part of the project.

Table 7
Payment Schedule and Termination Value

Payment Summary						
Year	Contract Payments (A)	Maintenance Services Fee (B)	Operations Monitoring Fee (C)	Other (Specify) (D)	Total Payments (E)=(A)+(B)+(C)+(D)	Termination Value (F)
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
TOTAL						

Notes: The maintenance service fee is for other than contractor-installed equipment. The Operations Monitoring Fee may be required for some projects. It is used to pay for third-party (state agency or independent consultant) monitoring of the contractor's performance. This fee is usually a set percentage of the Gross Annual Energy Cost Savings (1.5% has been used in some state governmental projects). The "Termination Value" is the lump sum payment required to buy out of the contract and receive title to all equipment in each year. If this option is not proposed in any year(s), indicate by "NA".

2. ESPC Workbook

This spreadsheet was prepared for the Federal Energy Management Program of the US Department of Energy by Andy Walker (National Renewable Energy Laboratory) , Steve Kromer (Lawrence Berkeley National Laboratory) and George Blakey and Mark Stetz (Schiller Associates)

INTRODUCTION

This workbook is designed to assist those involved with Energy Savings Performance Contracts (ESPCs) to quickly determine the viability of a particular project. By entering information about the costs of the project, the projected energy savings, and appropriate financial parameters, this workbook will calculate and display numeric information that will show whether the project will meet the federal guidelines, under EPACT. This workbook uses generalized financial calculations to approximate the actual costs of implementing an Energy Conservation Measure (ECM), but should not be taken to enumerate all the real costs of any such measure.

CONTENTS

The contents of this workbook are as follows:

1) **Introduction**	description of workbook; directions for use
2) **Front Page**	main entries; results displayed
3) **Contractor's Costs**	secondary entries; loadings calculated
4) **Energy Savings**	utility savings entries; total savings calculated
5) **Debt**	annual interest; payments and savings calculated
6) **Retrofit Sample**	example of projected savings from lighting retrofit

REQUIRED INFORMATION

You will need to have available the information listed below, in order to get the results desired.
(See the section below titled Assumptions for clarification.)

- the cost of the project: the cost of materials and the cost of the labor.
- the projected savings of the project: the units of energy (e.g. kwh for electrical energy) projected to be saved, their costs per unit, and costs of other affected utilities.
- the change in the costs of the operation and maintenance (O&M) of the facility as a result of the implementation of the ECM;
- the estimated life of the components of the ECMs;
- the parameters affecting the margins to a contractor's base costs: profit, overhead, design cost program management, insurance, construction interest, and tax (these can be either in actual dollars or as a percentage of the project's base cost.

- the interest rate and the term of the loan to finance the project;
- the current discount rate.

INSTRUCTIONS

The entry of data into this workbook is designed to be simple and straightforward. By using the tab key one can move the cursor around the individual pages, going to every area where an entry may be made. The user should begin on the *Front Page*. The top left section of this page is for the entry of the project's base cost, and the top right section shows the total projected savings for the ECMs. The bottom left section is where the various parameters are entered, and the bottom right section is where the results are displayed.

Some of the sections contain additional instructions for entering information on other pages of the workbook, depending on the data available. In all cases, the entered information will be blue in color.

The *Retrofit Example* page at the end of the workbook is for the user to see how the energy savings values can be calculated if the ECM includes a lighting retrofit. Some of the numbers in the chart can be changed in order for the user to see how a change of one variable will affect the results. None of the values on this page are linked to the other pages however, so any changes on this page will not affect the calculations or results of the project being analyzed.

All of the pages of this workbook will have values in place whenever it is opened for use. All of these values can be changed, if necessary. They can also be left in place for a preliminary analysis, until more accurate information becomes available.

ASSUMPTIONS

This workbook is intended as a preliminary screening tool for ESPC projects. The formulas and calculations used are designed to approximate the actual financial scenarios for the implementation of an ESPC, in order to see if the savings generated can justify the project's cost.

This version of the workbook does not include inflation factors in its calculations, so the annual savings and the annual payments figures will not be an exact picture of the proposed project's results, however they will be close enough to determine if a project is worth pursuing.

The build up of the margin elements are described next to each entry in the workbook.
The equations for the margins are included for demonstration purposes only. It is easy to change the equations to reflect your actual margins.

Project Costs (Base amount)

Materials	$	2,460
Labor	$	3,690
Total	**$**	**6,150**

Project Savings

Savings calculated from reduced energy use **$ 1,644**
(From Energy Savings page)

Financial Parameters

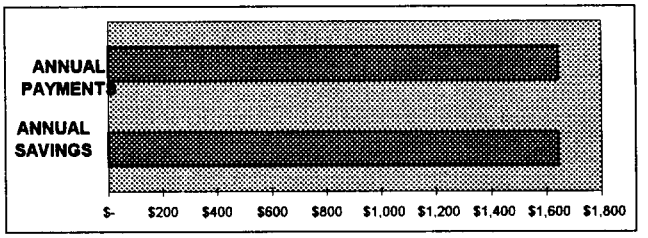
10.0 **Margin**

5.0 **M&V** - % of Annual Energy Savings
Project Lifetime (Average)- years

Market -
12.0 **Interest Rate** - %
6.1 **Term** - years
4.5 **Discount Rate** - %

Analysis Results

Total Margins	**$**	**697**
Total Project Cost	**$**	**6,847**
Total Interest Cost	**$**	**3,192**
Simple payback		**4.2** yrs.
Annual Payments	**$**	**1,644**
Annual Savings	**$**	**1,644**
Contractors' Share		**100%**



Contractor Costs Calculations

Materials	$	2,460		
Labor	$	3,690		
Total Base Cost	$	6,150		
Margins:				
Margin	$	615	10.00%	Margin
Subtotal	$	615		
M&V	$	82	5.00%	
Total Margins	$	697		
Total Project Cost	**$**	**6,847**		

Debt and Cashflow

Loan Term	**6**	years
Project Lifetime	**0**	years
Interest Rate (%)	**12.00**	
Annual Savings	**$ 1,644**	
Percent of savings for Contractor payment	**100%**	
Savings to Investment (SIR)	**0.2**	

Year	Loan Amount	Principal	Interest	Contract. Pay.		Energy Savings
0		$0	$0	$0		$ -
1	$ 6,847	($822)	($822)	($1,644)		$ 1,644
2		($921)	($723)	($1,644)		$ -
3		($1,031)	($613)	($1,644)		$ -
4		($1,155)	($489)	($1,644)		$ -
5		($1,293)	($350)	($1,644)		$ -
6		($1,448)	($195)	($1,644)		$ -
7		$0	$0	$0		$ -
8		$0	$0	$0		$ -
9		$0	$0	$0		$ -
10		$0	$0	$0		$ -
11		$0	$0	$0		$ -
12		$0	$0	$0		$ -
13		$0	$0	$0		$ -
14		$0	$0	$0		$ -
15		$0	$0	$0		$ -
16		$0	$0	$0		$ -
17		$0	$0	$0		$ -
18		$0	$0	$0		$ -
19		$0	$0	$0		$ -
20		$0	$0	$0		$ -
21		$0	$0	$0		$ -
22		$0	$0	$0		$ -
23		$0	$0	$0		$ -
24		$0	$0	$0		$ -
25		$0	$0	$0		$ -
Totals	$6,847	($6,670)	($3,192)	($9,861)		$ 1,644
			NPV	$8,477		$1,573

Note: The loan starts in year zero and finances all costs. There is no Contractor Equity.
Contractor should provide interest rates in disclosure (required for sole-source).
Construction interest is included on the contractor costs sheet.
Amount of loan is amount financed plus first year interest since payments don't start until the following year.

Retrofit Savings Example

	Existing					Retrofit			Annual SAVINGS	COST	
	Qty	kW/fix	kW	Hr/yr	kWh/Yr	kW/fix.	KW	kWh/Yr	kWh	Hardware	Labor
	200	0.115	23.000	3,337	76,751	0.050	10.0	33,370	43,381	$ 2,000.00	$ 3,000.00
	13	0.115	1.495	3,337	4,989	0.050	0.7	2,169	2,820	$ 130.00	$ 195.00
	20	0.115	2.300	3,337	7,675	0.050	1.0	3,337	4,338	$ 200.00	$ 300.00
	2	0.115	0.230	3,337	768	0.050	0.1	334	434	$ 20.00	$ 30.00
	2	0.115	0.230	3,337	768	0.050	0.1	334	434	$ 20.00	$ 30.00
	2	0.115	0.230	3,337	768	0.050	0.1	334	434	$ 20.00	$ 30.00
	3	0.115	0.345	3,337	1,151	0.050	0.2	501	651	$ 30.00	$ 45.00
	2	0.040	0.080	8,760	701	0.015	0.0	263	438	$ 20.00	$ 30.00
	2	0.040	0.080	8,760	701	0.015	0.0	263	438	$ 20.00	$ 30.00
Sub-total	**246**		**27.99**		**94,270**		**12.2**	**40903.3**	53,367	$ 2,460.00	$ 3,690.00
TOTAL									**53,367**		**$ 6,150**

Note: Hardware and Labor costs from Means data -

Ballast cost (each)	**$10.00**
Labor cost ($/hr)	**$15.00**

3. Scenario Evaluator

SCENARIO:

Installation Costs (H-2 & H-3)

Installation Price		$ 911,981
Overall Markup	23.3%	$ 212,338
TOTAL INVESTMENT		$ 1,124,319
Financing Procurement Costs		$ 14,816
TOTAL CAPITAL REQUIRED		$ 1,139,135

Cost Savings (H-1)

	First Year	Total
Estimated Savings	$ 118,436	$ 2,425,883
Guaranteed Savings	$ 118,436	$ 2,425,883
Contractor Payments	$ 116,086	$ 2,377,345

Contractor Share of Guarantee	98.00%
Gov't Share of Guarantee	2.00%

Savings %

ECMs ■ O & M

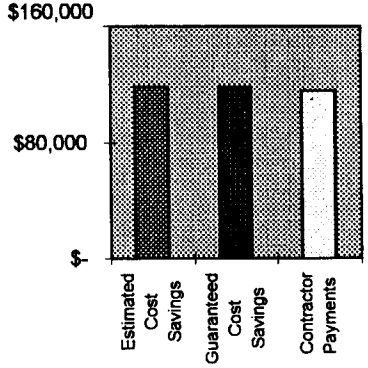
Performance Period Costs (H-3)

Total Costs

$ 26,870	Management/Admin
$ -	Operation
$ -	Maintenance
$ 65,394	Repair & Replacement
$ 61,668	Measurement & Verify
$ -	Permits & Licenses
$ -	Insurance & Tax
$ -	Property Taxes
$ -	Other
$ 153,932	SUB-TOTAL
$ 35,404	Margin
$ 189,336	TOTAL

Markup: 23.0%

Annual Cost Savings & Contractor Payments



Financing

Term (yrs)	20
Equipment Life	

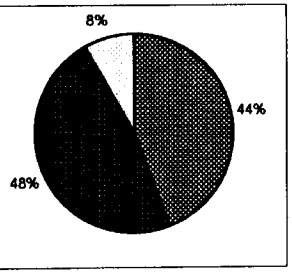
Interest

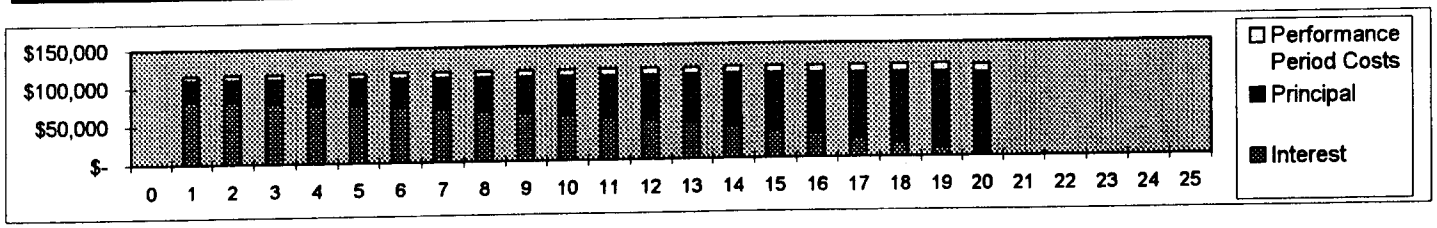
T-Bill	7.40%	$ 1,047,140
Margin	0.00%	$ -
Total	7.40%	$ 1,047,140

Distribution of Payments (H-3)

CAPITAL REQUIRED	$ 1,139,135	
PROJECT LIFETIME PAYMENTS		
Interest	$ 1,047,140	44%
Principal	$ 1,139,135	48%
Performance Period Costs	$ 189,336	8%
Total	$ 2,375,612	

Distribution of Payments (%)





Super ESPC Financial Input Spreadsheet - Western DOE Region

PROJECT CONSTRUCTION PHASE COSTS INPUT SHEET

If ECMs have different markups, adjust in table below.

Annual Escalation Rate for Utility Rates

Consumer Price Index - Annual Inflation Factor (applied to Annual O&M Savings)

Consumer Price Index - Annual Inflation Factor (applied to Performance Period Costs)

Facility Loan Payment to be made at Start or End of each year? (Annual Payments only. Affects Loan Amount and Term)

Used to calculate Procurement Financing Costs below

This is the difference between Annual Guaranteed Savings and the Annual Contractor Payments (H-1)

General Information	
Project Name	Jefferson
Contractor Name	ESCO
Year Payments Start	2001

Economic Factors	
Utility Rate Escalation	0.0%
O & M Savings Escalation	1.5%
Performance Period Inflation	3.0%
Annual or Monthly Payments (A/M)	M
Payments at End or Beginning of Year? (0 = End, 1 = Start)	0
Construction Period (# of months)	8

Financial	
Markup	23.0%
Loan Term (yrs)	20
Calculated Term to Payoff	20
Loan Rate	7.40%
Termination Fee	5.0%
Financing Procurement Costs	$14,816
DES Study	$0
DES Reimbursement	$0
Gov't Retained Savings	2.0%
Utility Rebate	$11,250

Financing Rate	
T-Bill	7.40%
Margin	0.00%
TBill Source	Wall St Journal
Issue Date	6/2/99

ECM Information

Include in project (1= Yes)	ECM #	ECM	Direct Job Cost (no markup)	Markup	Annual Savings Depreciation	Savings Depreciation Multiplier	Savings Guarantee	Energy Cost Savings	O&M Cost Savings	Total Savings	Total Investment	Simple Payback
1	1.01	Install New Modular Natural Gas Hot	$288,459	23%		100%	100%	$45,001	$15,100	$60,101	$354,804	5.9
1	1.02	Convert Existing Electric DHW Syste	$37,762	23%		100%	100%	$5,200	$0	$5,200	$46,447	8.9
1	3.01	Install Campus Wide DDC Control Sy	$253,920	23%		100%	100%	$7,943	$3,200	$11,143	$312,321	28.0
1	5.01	Lighting System Improvements	$243,250	23%		100%	100%	$15,137	$0	$15,137	$299,197	19.8
1	7.01	Convert Constant HW and CW Loops	$99,820	23%		100%	100%	$26,855	$0	$26,855	$122,779	4.6
1				23%		100%	100%			$0	$0	
1				23%		100%	100%			$0	$0	
1				23%		100%	100%			$0	$0	
1				23%		100%	100%			$0	$0	
1				23%		100%	100%			$0	$0	
1				23%		100%	100%			$0	$0	
1				23%		100%	100%			$0	$0	
1				23%		100%	100%			$0	$0	
1				23%		100%	100%			$0	$0	
0				23%		100%	100%			$0	$0	0.0
0				23%		100%	100%			$0	$0	0.0
0				23%		100%	100%			$0	$0	0.0
0				23%		100%	100%			$0	$0	0.0
0				23%		100%	100%			$0	$0	0.0
0				23%		100%	100%			$0	$0	0.0
Insert new rows on line above. Highlight two rows above and drag down.												
Totals			$ 923,211					$100,136	$18,300	$118,436	$1,124,319	9.5

Rebate Applied (1=yes; 0=no)
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0
0

PERFORMANCE PERIOD COSTS INPUT SHEET

Project Site: Jefferson

PROJECT CAPITALIZATION

Total Investment (H-2 Total)	$1,124,319	
Financing Procurement Cost	Known	Estimated
	$14,816	$0
TOTAL CAPITAL REQUIRED	$1,139,135	

This is the Total investment x Construction Period / 2 x Loan Rate / 12

ANNUAL RECURRING EXPENSES

Performance Period Expenses:	Annual $	% escalation
Management/Administration	$1,000	3.0%
Operation	$0	3.0%
Maintenance	$0	3.0%
Repair and Replacement	$2,434	3.0%
Measurement and Verification	$2,295	3.0%
Permits and Licenses		3.0%
Insurance		3.0%
Property Taxes		3.0%
Other		3.0%
Subtotal Performance Period Costs	$ 5,729	
Performance Period Markup	23.00%	
Total Performance Period Costs (Year 1)	$ 7,046	

NON RECURRING EXPENSES

Calendar Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Project Year	1	2	3	4	5	6	7	8	9	10
Performance Period Expenses:										
Management/Administration										
Operation										
Maintenance										
Repair and Replacement										
Measurement and Verification										
Permits and Licenses										
Insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Property Taxes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Negative Amortization										

PERFORMANCE PERIOD COSTS INPUT SHEET

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Total
11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	
										$ -	$ -	$ -	$ -	$ -	$ -
										$ -	$ -	$ -	$ -	$ -	$ -
										$ -	$ -	$ -	$ -	$ -	$ -
										$ -	$ -	$ -	$ -	$ -	$ -
										$ -	$ -	$ -	$ -	$ -	$ -
										$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
										-$4,958	-$5,325	-$5,719	-$6,142	-$6,598	

SCHEDULE H-1 -- DELIVERY ORDER
GUARANTEED ANNUAL COST SAVINGS AND CONTRACTOR PAYMENTS

The Contractor shall complete the following statement:
If selected, the Contractor shall complete the installation of all proposed ECMs not later than _____ months after delivery order award.

Project Name: Jefferson **Contractor:** ESCO

Year	Annual Estimated Cost Savings $	Annual Guaranteed Cost Savings $	Annual Contractor Payments $
1	$ 118,436	$ 118,436	$ 116,066
2	$ 118,711	$ 118,711	$ 116,335
3	$ 118,989	$ 118,989	$ 116,608
4	$ 119,272	$ 119,272	$ 116,885
5	$ 119,559	$ 119,559	$ 117,167
6	$ 119,850	$ 119,850	$ 117,452
7	$ 120,146	$ 120,146	$ 117,742
8	$ 120,446	$ 120,446	$ 118,036
9	$ 120,751	$ 120,751	$ 118,335
10	$ 121,060	$ 121,060	$ 118,638
11	$ 121,374	$ 121,374	$ 118,945
12	$ 121,692	$ 121,692	$ 119,258
13	$ 122,016	$ 122,016	$ 119,574
14	$ 122,344	$ 122,344	$ 119,896
15	$ 122,677	$ 122,677	$ 120,223
16	$ 123,015	$ 123,015	$ 120,554
17	$ 123,358	$ 123,358	$ 120,890
18	$ 123,707	$ 123,707	$ 121,232
19	$ 124,060	$ 124,060	$ 121,578
20	$ 124,419	$ 124,419	$ 121,930
21	$ -	$ -	$ -
22	$ -	$ -	$ -
23	$ -	$ -	$ -
24	$ -	$ -	$ -
25	$ -	$ -	$ -
TOTALS	$ 2,425,883	$ 2,425,883	$ 2,377,345

SCHEDULE H-2 – DELIVERY ORDER
ECMs - INVESTMENT

Project Name: Jefferson **Contractor: ESCO**

ECM No.	Equipment Description - Title	Installation Pric	Markup %	Markup	Investment	Simple Payback
1.01	Install New Modular Natural Gas Hot Water Boilers	$ 288,459	23%	$ 66,346	$ 354,804	5.9
1.02	Convert Existing Electric DHW System to Natural Gas DHW Heater	$ 37,762	23%	$ 8,685	$ 46,447	8.9
3.01	Install Campus Wide DDC Control System	$ 253,920	23%	$ 58,401	$ 312,321	28.0
5.01	Lighting System Improvements	$ 243,250	23%	$ 55,947	$ 299,197	19.8
7.01	Convert Constant HW and CW Loops to Variable Flow	$ 99,820	23%	$ 22,959	$ 122,779	4.6
0	0	$ -		$ -	$ -	
0	0	$ -		$ -	$ -	
0	0	$ -		$ -	$ -	
0	0	$ -		$ -	$ -	
0	0	$ -		$ -	$ -	
0	0	$ -		$ -	$ -	
0	0	$ -		$ -	$ -	
0	0	$ -		$ -	$ -	
0	0	$ -		$ -	$ -	
		$ -		$ -	$ -	0.0
		$ -		$ -	$ -	0.0
		$ -		$ -	$ -	0.0
		$ -		$ -	$ -	0.0
		$ -		$ -	$ -	0.0
		$ -		$ -	$ -	0.0
	Detailed Energy Study	$ -			$ -	
	Audit Reimbursement	$ -			$ -	
	Utility Rebate	$ (11,230)			$ (11,230)	
Total		$ 911,981		$ 212,338	$ 1,124,319	9.5

SCHEDULE H-3 – DELIVERY ORDER
CONTRACTOR PERFORMANCE PERIOD CASH FLOW

Project Name: Jefferson	Contractor: ESCO		
Project Capitalization			
Total Investment (H-2 Total)	$ 1,124,319		
Financing Procurement Cost	$ 14,816	equals 1.32% of total	Principal Repaid
TOTAL CAPITAL REQUIRED	$ 1,139,135	(minus audit costs)	$1,139,135

Calendar Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Project Year	0	1	2	3	4	5	6	7	8	9	10	11	12	13
Annual Cash Flow														
Debt Service														
Interest		$83,440	$81,479	$79,365	$77,084	$74,624	$71,972	$69,114	$66,034	$62,715	$59,139	$55,286	$51,136	$46,666
Principal	$0	$25,580	$27,598	$29,768	$32,102	$34,612	$37,311	$40,214	$43,336	$46,694	$50,306	$54,190	$58,368	$62,862
Total Debt Service	$0	$ 109,020	$ 109,078	$ 109,133	$ 109,186	$ 109,236	$ 109,284	$ 109,328	$ 109,370	$ 109,409	$ 109,444	$ 109,476	$ 109,504	$ 109,528
Performance Period Costs														
Management/Administration		$ 1,000	$ 1,030	$ 1,061	$ 1,093	$ 1,126	$ 1,159	$ 1,194	$ 1,230	$ 1,267	$ 1,305	$ 1,344	$ 1,384	$ 1,426
Operation		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Maintenance		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repair and Replacement		$ 2,434	$ 2,507	$ 2,582	$ 2,659	$ 2,739	$ 2,821	$ 2,906	$ 2,993	$ 3,083	$ 3,175	$ 3,271	$ 3,369	$ 3,470
Measurement and Verification		$ 2,295	$ 2,364	$ 2,435	$ 2,508	$ 2,583	$ 2,661	$ 2,740	$ 2,823	$ 2,907	$ 2,994	$ 3,084	$ 3,177	$ 3,272
Permits and Licenses		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Insurance		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Property Taxes		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other:		$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal Performance Period Costs		$ 5,729	$ 5,901	$ 6,078	$ 6,260	$ 6,448	$ 6,641	$ 6,840	$ 7,046	$ 7,257	$ 7,475	$ 7,699	$ 7,930	$ 8,168
Performance Period Markup	23.00%	$ 1,318	$ 1,357	$ 1,398	$ 1,440	$ 1,483	$ 1,527	$ 1,573	$ 1,620	$ 1,669	$ 1,719	$ 1,771	$ 1,824	$ 1,879
Total Performance Period Costs		$ 7,046	$ 7,258	$ 7,475	$ 7,700	$ 7,931	$ 8,169	$ 8,414	$ 8,666	$ 8,926	$ 9,194	$ 9,470	$ 9,754	$ 10,046
Total Annual Contractor Payments (=Debt Service + Performance Period Costs	$0	$ 116,066	$ 116,336	$ 116,608	$ 116,885	$ 117,167	$ 117,452	$ 117,742	$ 118,036	$ 118,335	$ 118,638	$ 118,945	$ 119,258	$ 119,574

Financing Summary		T-Bill/T-Note Reference:	
Loan Rate	7.40%	Interest Rate	7.40%
Term	20 yr	Index Margin	0.00%
		Issue Date	6/2/99

Calendar Year	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	Totals
Project Year	14	15	16	17	18	19	20	21	22	23	24	25	
Annual Cash Flow													
Debt Service													
Interest	$41,853	$36,669	$31,088	$25,079	$18,609	$11,643	$4,145	$0	$0	$0	$0	$0	$1,047,140
Principal	$67,696	$72,895	$78,486	$84,504	$90,977	$97,939	$103,695	$0	$0	$0	$0	$0	$ 1,139,135
Total Debt Service	$ 109,548	$ 109,564	$ 109,576	$ 109,583	$ 109,586	$ 109,582	$ 107,840	$ -	$ -	$ -	$ -	$ -	$ 2,186,275
Performance Period Costs													
Management/Administration	$ 1,469	$ 1,513	$ 1,558	$ 1,605	$ 1,653	$ 1,702	$ 1,754	$ -	$ -	$ -	$ -	$ -	$ 26,870
Operation	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Maintenance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Repair and Replacement	$ 3,574	$ 3,681	$ 3,792	$ 3,905	$ 4,023	$ 4,143	$ 4,267	$ -	$ -	$ -	$ -	$ -	$ 65,364
Measurement and Verification	$ 3,370	$ 3,471	$ 3,576	$ 3,683	$ 3,793	$ 3,907	$ 4,024	$ -	$ -	$ -	$ -	$ -	$ 61,866
Permits and Licenses	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Insurance	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Property Taxes	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Other:	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -	$ -
Subtotal Performance Period Costs	$ 8,413	$ 8,665	$ 8,925	$ 9,193	$ 9,469	$ 9,753	$ 10,045	$ -	$ -	$ -	$ -	$ -	$ 153,932
Performance Period Markup	$ 1,935	$ 1,993	$ 2,053	$ 2,114	$ 2,178	$ 2,243	$ 2,310	$ -	$ -	$ -	$ -	$ -	$ 35,404
Total Performance Period Costs	$ 10,348	$ 10,658	$ 10,978	$ 11,307	$ 11,646	$ 11,996	$ 12,356	$ -	$ -	$ -	$ -	$ -	$ 189,336
Total Annual Contractor Payments (=Debt Service + Performance Period Costs	$ 119,896	$ 120,223	$ 120,554	$ 120,890	$ 121,232	$ 121,578	$ 120,196	$ -	$ -	$ -	$ -	check sum> $	$ 2,375,612
													$ 2,375,612

SCHEDULE H-5 -- DELIVERY ORDER
CANCELLATION CEILING

This table reflects a 5% Termination Fee.

Project Name: Jefferson	Contractor Name: ESCO

Year	Outstanding Principal Balance $	Termination Fee $	Total Cancellation Ceiling $
ONE	$ 83,440	$ 4,172	$ 87,612
TWO	$ 81,479	$ 4,074	$ 85,553
THREE	$ 79,365	$ 3,968	$ 83,333
FOUR	$ 77,084	$ 3,854	$ 80,938
FIVE	$ 74,624	$ 3,731	$ 78,355
SIX	$ 71,972	$ 3,599	$ 75,571
SEVEN	$ 69,114	$ 3,456	$ 72,570
EIGHT	$ 66,034	$ 3,302	$ 69,336
NINE	$ 62,715	$ 3,136	$ 65,850
TEN	$ 59,139	$ 2,957	$ 62,095
ELEVEN	$ 55,286	$ 2,764	$ 58,050
TWELVE	$ 51,136	$ 2,557	$ 53,693
THIRTEEN	$ 46,666	$ 2,333	$ 49,000
FOURTEEN	$ 41,853	$ 2,093	$ 43,946
FIFTEEN	$ 36,669	$ 1,833	$ 38,503
SIXTEEN	$ 31,088	$ 1,554	$ 32,642
SEVENTEEN	$ 25,079	$ 1,254	$ 26,332
EIGHTEEN	$ 18,609	$ 930	$ 19,539
NINETEEN	$ 11,643	$ 582	$ 12,226
TWENTY	$ 4,145	$ 207	$ 4,353
TWENTY-ONE	$ -	$ -	$ -
TWENTY-TWO	$ -	$ -	$ -
TWENTY-THREE	$ -	$ -	$ -
TWENTY-FOUR	$ -	$ -	$ -
TWENTY-FIVE	$ -	$ -	$ -

Finance Section	Interest	Principal	Term
	7.40%	$ 1,139,135	20

PAYMENT SCHEDULE - ANNUAL ROLLUP FROM MONTHLY CALCULATION

Contract Year	Calendar Year	Total Contractor Payments from H-1	Less: Maintenance Payments from H-3	Total Debt Service Payments	Interest Paid	Principal Paid
0						
1	2001	$ 116,066	$ 7,046	$ 109,020	$ 83,440	$ 25,580
2	2002	$ 116,335	$ 7,258	$ 109,078	$ 81,479	$ 27,598
3	2003	$ 116,608	$ 7,475	$ 109,133	$ 79,365	$ 29,768
4	2004	$ 116,885	$ 7,700	$ 109,186	$ 77,084	$ 32,102
5	2005	$ 117,167	$ 7,931	$ 109,236	$ 74,624	$ 34,612
6	2006	$ 117,452	$ 8,169	$ 109,284	$ 71,972	$ 37,311
7	2007	$ 117,742	$ 8,414	$ 109,328	$ 69,114	$ 40,214
8	2008	$ 118,036	$ 8,666	$ 109,370	$ 66,034	$ 43,336
9	2009	$ 118,335	$ 8,926	$ 109,409	$ 62,715	$ 46,694
10	2010	$ 118,638	$ 9,194	$ 109,444	$ 59,139	$ 50,306
11	2011	$ 118,945	$ 9,470	$ 109,476	$ 55,286	$ 54,190
12	2012	$ 119,258	$ 9,754	$ 109,504	$ 51,136	$ 58,368
13	2013	$ 119,574	$ 10,046	$ 109,528	$ 46,666	$ 62,862
14	2014	$ 119,896	$ 10,348	$ 109,548	$ 41,853	$ 67,696
15	2015	$ 120,223	$ 10,658	$ 109,564	$ 36,669	$ 72,895
16	2016	$ 120,554	$ 10,978	$ 109,576	$ 31,088	$ 78,488
17	2017	$ 120,890	$ 11,307	$ 109,583	$ 25,079	$ 84,504
18	2018	$ 121,232	$ 11,646	$ 109,585	$ 18,609	$ 90,977
19	2019	$ 121,578	$ 11,996	$ 109,582	$ 11,643	$ 97,939
20	2020	$ 121,930	$ 12,356	$ 109,574	$ 4,145	$ 103,695
21	2021	$ -	$ -	$ -	$ -	$ -
22	2022	$ -	$ -	$ -	$ -	$ -
23	2023	$ -	$ -	$ -	$ -	$ -
24	2024	$ -	$ -	$ -	$ -	$ -
25	2025	$ -	$ -	$ -	$ -	$ -
		$ 2,377,345	$ 189,336	$ 2,188,009	$ 1,047,140	$ 1,139,135
					Years to Pay off Investment	20

Finance Section	Interest	Principal	Years	EOY=0, BOY=1
	7.40%	$ 1,139,135	20	0

PAYMENT SCHEDULE - ANNUAL CALCULATION

Calendar Year	Interest	Total Contractor Payments	Maintenance Payments	Available For Debt Service	Remaining Balance	Principal Paid
					$ 1,139,135	$ -
2001	$ 84,296	$ 116,066	$ 7,046	$ 109,020	$ 1,114,411	$ 24,724
2002	$ 82,466	$ 116,335	$ 7,258	$ 109,078	$ 1,087,800	$ 26,611
2003	$ 80,497	$ 116,608	$ 7,475	$ 109,133	$ 1,059,164	$ 28,636
2004	$ 78,378	$ 116,885	$ 7,700	$ 109,186	$ 1,028,356	$ 30,808
2005	$ 76,098	$ 117,167	$ 7,931	$ 109,236	$ 995,219	$ 33,138
2006	$ 73,646	$ 117,452	$ 8,169	$ 109,284	$ 959,581	$ 35,638
2007	$ 71,009	$ 117,742	$ 8,414	$ 109,328	$ 921,262	$ 38,319
2008	$ 68,173	$ 118,036	$ 8,666	$ 109,370	$ 880,065	$ 41,197
2009	$ 65,125	$ 118,335	$ 8,926	$ 109,409	$ 835,781	$ 44,284
2010	$ 61,848	$ 118,638	$ 9,194	$ 109,444	$ 788,184	$ 47,596
2011	$ 58,326	$ 118,945	$ 9,470	$ 109,476	$ 737,034	$ 51,150
2012	$ 54,541	$ 119,258	$ 9,754	$ 109,504	$ 682,071	$ 54,963
2013	$ 50,473	$ 119,574	$ 10,046	$ 109,528	$ 623,016	$ 59,055
2014	$ 46,103	$ 119,896	$ 10,348	$ 109,548	$ 559,571	$ 63,445
2015	$ 41,408	$ 120,223	$ 10,658	$ 109,564	$ 491,415	$ 68,156
2016	$ 36,365	$ 120,554	$ 10,978	$ 109,576	$ 418,203	$ 73,211
2017	$ 30,947	$ 120,890	$ 11,307	$ 109,583	$ 339,367	$ 78,636
2018	$ 25,128	$ 121,232	$ 11,646	$ 109,585	$ 255,110	$ 84,457
2019	$ 18,878	$ 121,578	$ 11,996	$ 109,582	$ 164,406	$ 90,704
2020	$ 12,166	$ 121,930	$ 12,356	$ 109,574	$ 66,998	$ 97,408
2021	$ 4,958	$ -	$ -	$ -	$ 71,955	$ (4,958)
2022	$ 5,325	$ -	$ -	$ -	$ 77,280	$ (5,325)
2023	$ 5,719	$ -	$ -	$ -	$ 82,999	$ (5,719)
2024	$ 6,142	$ -	$ -	$ -	$ 89,141	$ (6,142)
2025	$ 6,596	$ -	$ -	$ -	$ 95,737	$ (6,596)
		$ 2,377,345	$ 189,336	$ 2,188,009		$ 1,043,398
					Years to Pay off Investment	20

PAYMENT SCHEDULE - MONTHLY CALCULATION

START DATE MONTH	YEAR							
12	2000							
Calendar Month	Contract Month	Payment Number	Total Payment	Less: Maintenance Payment	Debt Service Payments	Interest	Principal	Principal Balance Remaining
Dec-00	0	0						$ 1,139,135
Jan-01	1	1	$ 9,672	$ 587	$ 9,085	$ 7,025	$ 2,060	$ 1,137,075
Feb-01	2	2	$ 9,672	$ 587	$ 9,085	$ 7,012	$ 2,073	$ 1,135,002
Mar-01	3	3	$ 9,672	$ 587	$ 9,085	$ 6,999	$ 2,086	$ 1,132,916
Apr-01	4	4	$ 9,672	$ 587	$ 9,085	$ 6,986	$ 2,099	$ 1,130,817
May-01	5	5	$ 9,672	$ 587	$ 9,085	$ 6,973	$ 2,112	$ 1,128,705
Jun-01	6	6	$ 9,672	$ 587	$ 9,085	$ 6,960	$ 2,125	$ 1,126,581
Jul-01	7	7	$ 9,672	$ 587	$ 9,085	$ 6,947	$ 2,138	$ 1,124,443
Aug-01	8	8	$ 9,672	$ 587	$ 9,085	$ 6,934	$ 2,151	$ 1,122,292
Sep-01	9	9	$ 9,672	$ 587	$ 9,085	$ 6,921	$ 2,164	$ 1,120,128
Oct-01	10	10	$ 9,672	$ 587	$ 9,085	$ 6,907	$ 2,178	$ 1,117,950
Nov-01	11	11	$ 9,672	$ 587	$ 9,085	$ 6,894	$ 2,191	$ 1,115,759
Dec-01	12	12	$ 9,672	$ 587	$ 9,085	$ 6,881	$ 2,204	$ 1,113,555
Jan-02	13	13	$ 9,695	$ 605	$ 9,090	$ 6,867	$ 2,223	$ 1,111,332
Feb-02	14	14	$ 9,695	$ 605	$ 9,090	$ 6,853	$ 2,237	$ 1,109,095
Mar-02	15	15	$ 9,695	$ 605	$ 9,090	$ 6,839	$ 2,250	$ 1,106,845
Apr-02	16	16	$ 9,695	$ 605	$ 9,090	$ 6,826	$ 2,264	$ 1,104,581
May-02	17	17	$ 9,695	$ 605	$ 9,090	$ 6,812	$ 2,278	$ 1,102,303
Jun-02	18	18	$ 9,695	$ 605	$ 9,090	$ 6,798	$ 2,292	$ 1,100,010
Jul-02	19	19	$ 9,695	$ 605	$ 9,090	$ 6,783	$ 2,306	$ 1,097,704
Aug-02	20	20	$ 9,695	$ 605	$ 9,090	$ 6,769	$ 2,321	$ 1,095,383
Sep-02	21	21	$ 9,695	$ 605	$ 9,090	$ 6,755	$ 2,335	$ 1,093,048
Oct-02	22	22	$ 9,695	$ 605	$ 9,090	$ 6,740	$ 2,349	$ 1,090,699
Nov-02	23	23	$ 9,695	$ 605	$ 9,090	$ 6,726	$ 2,364	$ 1,088,335
Dec-02	24	24	$ 9,695	$ 605	$ 9,090	$ 6,711	$ 2,378	$ 1,085,957
Jan-03	25	25	$ 9,717	$ 623	$ 9,094	$ 6,697	$ 2,398	$ 1,083,559
Feb-03	26	26	$ 9,717	$ 623	$ 9,094	$ 6,682	$ 2,412	$ 1,081,147
Mar-03	27	27	$ 9,717	$ 623	$ 9,094	$ 6,667	$ 2,427	$ 1,078,719
Apr-03	28	28	$ 9,717	$ 623	$ 9,094	$ 6,652	$ 2,442	$ 1,076,277
May-03	29	29	$ 9,717	$ 623	$ 9,094	$ 6,637	$ 2,457	$ 1,073,820
Jun-03	30	30	$ 9,717	$ 623	$ 9,094	$ 6,622	$ 2,473	$ 1,071,347
Jul-03	31	31	$ 9,717	$ 623	$ 9,094	$ 6,607	$ 2,488	$ 1,068,859
Aug-03	32	32	$ 9,717	$ 623	$ 9,094	$ 6,591	$ 2,503	$ 1,066,356
Sep-03	33	33	$ 9,717	$ 623	$ 9,094	$ 6,576	$ 2,519	$ 1,063,838
Oct-03	34	34	$ 9,717	$ 623	$ 9,094	$ 6,560	$ 2,534	$ 1,061,304
Nov-03	35	35	$ 9,717	$ 623	$ 9,094	$ 6,545	$ 2,550	$ 1,058,754
Dec-03	36	36	$ 9,717	$ 623	$ 9,094	$ 6,529	$ 2,565	$ 1,056,188
Jan-04	37	37	$ 9,740	$ 642	$ 9,099	$ 6,513	$ 2,586	$ 1,053,603
Feb-04	38	38	$ 9,740	$ 642	$ 9,099	$ 6,497	$ 2,602	$ 1,051,001
Mar-04	39	39	$ 9,740	$ 642	$ 9,099	$ 6,481	$ 2,618	$ 1,048,384
Apr-04	40	40	$ 9,740	$ 642	$ 9,099	$ 6,465	$ 2,634	$ 1,045,750
May-04	41	41	$ 9,740	$ 642	$ 9,099	$ 6,449	$ 2,650	$ 1,043,100
Jun-04	42	42	$ 9,740	$ 642	$ 9,099	$ 6,432	$ 2,666	$ 1,040,433
Jul-04	43	43	$ 9,740	$ 642	$ 9,099	$ 6,416	$ 2,683	$ 1,037,751
Aug-04	44	44	$ 9,740	$ 642	$ 9,099	$ 6,399	$ 2,699	$ 1,035,051
Sep-04	45	45	$ 9,740	$ 642	$ 9,099	$ 6,383	$ 2,716	$ 1,032,335
Oct-04	46	46	$ 9,740	$ 642	$ 9,099	$ 6,366	$ 2,733	$ 1,029,602
Nov-04	47	47	$ 9,740	$ 642	$ 9,099	$ 6,349	$ 2,750	$ 1,026,853
Dec-04	48	48	$ 9,740	$ 642	$ 9,099	$ 6,332	$ 2,767	$ 1,024,086
Jan-05	49	49	$ 9,764	$ 661	$ 9,103	$ 6,315	$ 2,788	$ 1,021,298
Feb-05	50	50	$ 9,764	$ 661	$ 9,103	$ 6,298	$ 2,805	$ 1,018,493
Mar-05	51	51	$ 9,764	$ 661	$ 9,103	$ 6,281	$ 2,822	$ 1,015,671
Apr-05	52	52	$ 9,764	$ 661	$ 9,103	$ 6,263	$ 2,840	$ 1,012,831
May-05	53	53	$ 9,764	$ 661	$ 9,103	$ 6,246	$ 2,857	$ 1,009,974
Jun-05	54	54	$ 9,764	$ 661	$ 9,103	$ 6,228	$ 2,875	$ 1,007,099
Jul-05	55	55	$ 9,764	$ 661	$ 9,103	$ 6,210	$ 2,893	$ 1,004,207
Aug-05	56	56	$ 9,764	$ 661	$ 9,103	$ 6,193	$ 2,910	$ 1,001,296

Sep-05	57	57	$	9,764	$	661	$	9,103	$	6,175	$	2,928	$	998,368
Oct-05	58	58	$	9,764	$	661	$	9,103	$	6,157	$	2,946	$	995,422
Nov-05	59	59	$	9,764	$	661	$	9,103	$	6,138	$	2,965	$	992,457
Dec-05	60	60	$	9,764	$	661	$	9,103	$	6,120	$	2,983	$	989,474
Jan-06	61	61	$	9,788	$	681	$	9,107	$	6,102	$	3,005	$	986,469
Feb-06	62	62	$	9,788	$	681	$	9,107	$	6,083	$	3,024	$	983,445
Mar-06	63	63	$	9,788	$	681	$	9,107	$	6,065	$	3,042	$	980,403
Apr-06	64	64	$	9,788	$	681	$	9,107	$	6,046	$	3,061	$	977,342
May-06	65	65	$	9,788	$	681	$	9,107	$	6,027	$	3,080	$	974,262
Jun-06	66	66	$	9,788	$	681	$	9,107	$	6,008	$	3,099	$	971,163
Jul-06	67	67	$	9,788	$	681	$	9,107	$	5,989	$	3,118	$	968,045
Aug-06	68	68	$	9,788	$	681	$	9,107	$	5,970	$	3,137	$	964,907
Sep-06	69	69	$	9,788	$	681	$	9,107	$	5,950	$	3,157	$	961,750
Oct-06	70	70	$	9,788	$	681	$	9,107	$	5,931	$	3,176	$	958,574
Nov-06	71	71	$	9,788	$	681	$	9,107	$	5,911	$	3,196	$	955,379
Dec-06	72	72	$	9,788	$	681	$	9,107	$	5,892	$	3,215	$	952,163
Jan-07	73	73	$	9,812	$	701	$	9,111	$	5,872	$	3,239	$	948,924
Feb-07	74	74	$	9,812	$	701	$	9,111	$	5,852	$	3,259	$	945,665
Mar-07	75	75	$	9,812	$	701	$	9,111	$	5,832	$	3,279	$	942,386
Apr-07	76	76	$	9,812	$	701	$	9,111	$	5,811	$	3,299	$	939,087
May-07	77	77	$	9,812	$	701	$	9,111	$	5,791	$	3,320	$	935,767
Jun-07	78	78	$	9,812	$	701	$	9,111	$	5,771	$	3,340	$	932,427
Jul-07	79	79	$	9,812	$	701	$	9,111	$	5,750	$	3,361	$	929,066
Aug-07	80	80	$	9,812	$	701	$	9,111	$	5,729	$	3,381	$	925,685
Sep-07	81	81	$	9,812	$	701	$	9,111	$	5,708	$	3,402	$	922,282
Oct-07	82	82	$	9,812	$	701	$	9,111	$	5,687	$	3,423	$	918,859
Nov-07	83	83	$	9,812	$	701	$	9,111	$	5,666	$	3,444	$	915,415
Dec-07	84	84	$	9,812	$	701	$	9,111	$	5,645	$	3,466	$	911,949
Jan-08	85	85	$	9,836	$	722	$	9,114	$	5,624	$	3,490	$	908,458
Feb-08	86	86	$	9,836	$	722	$	9,114	$	5,602	$	3,512	$	904,946
Mar-08	87	87	$	9,836	$	722	$	9,114	$	5,581	$	3,534	$	901,413
Apr-08	88	88	$	9,836	$	722	$	9,114	$	5,559	$	3,555	$	897,857
May-08	89	89	$	9,836	$	722	$	9,114	$	5,537	$	3,577	$	894,280
Jun-08	90	90	$	9,836	$	722	$	9,114	$	5,515	$	3,599	$	890,680
Jul-08	91	91	$	9,836	$	722	$	9,114	$	5,493	$	3,622	$	887,059
Aug-08	92	92	$	9,836	$	722	$	9,114	$	5,470	$	3,644	$	883,415
Sep-08	93	93	$	9,836	$	722	$	9,114	$	5,448	$	3,666	$	879,748
Oct-08	94	94	$	9,836	$	722	$	9,114	$	5,425	$	3,689	$	876,059
Nov-08	95	95	$	9,836	$	722	$	9,114	$	5,402	$	3,712	$	872,347
Dec-08	96	96	$	9,836	$	722	$	9,114	$	5,379	$	3,735	$	868,613
Jan-09	97	97	$	9,861	$	744	$	9,117	$	5,356	$	3,761	$	864,852
Feb-09	98	98	$	9,861	$	744	$	9,117	$	5,333	$	3,784	$	861,068
Mar-09	99	99	$	9,861	$	744	$	9,117	$	5,310	$	3,807	$	857,260
Apr-09	100	100	$	9,861	$	744	$	9,117	$	5,286	$	3,831	$	853,429
May-09	101	101	$	9,861	$	744	$	9,117	$	5,263	$	3,855	$	849,575
Jun-09	102	102	$	9,861	$	744	$	9,117	$	5,239	$	3,878	$	845,696
Jul-09	103	103	$	9,861	$	744	$	9,117	$	5,215	$	3,902	$	841,794
Aug-09	104	104	$	9,861	$	744	$	9,117	$	5,191	$	3,926	$	837,868
Sep-09	105	105	$	9,861	$	744	$	9,117	$	5,167	$	3,951	$	833,917
Oct-09	106	106	$	9,861	$	744	$	9,117	$	5,142	$	3,975	$	829,942
Nov-09	107	107	$	9,861	$	744	$	9,117	$	5,118	$	3,999	$	825,943
Dec-09	108	108	$	9,861	$	744	$	9,117	$	5,093	$	4,024	$	821,919
Jan-10	109	109	$	9,886	$	766	$	9,120	$	5,068	$	4,052	$	817,867
Feb-10	110	110	$	9,886	$	766	$	9,120	$	5,044	$	4,077	$	813,790
Mar-10	111	111	$	9,886	$	766	$	9,120	$	5,018	$	4,102	$	809,688
Apr-10	112	112	$	9,886	$	766	$	9,120	$	4,993	$	4,127	$	805,561
May-10	113	113	$	9,886	$	766	$	9,120	$	4,968	$	4,153	$	801,408
Jun-10	114	114	$	9,886	$	766	$	9,120	$	4,942	$	4,178	$	797,230
Jul-10	115	115	$	9,886	$	766	$	9,120	$	4,916	$	4,204	$	793,026
Aug-10	116	116	$	9,886	$	766	$	9,120	$	4,890	$	4,230	$	788,796
Sep-10	117	117	$	9,886	$	766	$	9,120	$	4,864	$	4,256	$	784,539
Oct-10	118	118	$	9,886	$	766	$	9,120	$	4,838	$	4,282	$	780,257
Nov-10	119	119	$	9,886	$	766	$	9,120	$	4,812	$	4,309	$	775,948
Dec-10	120	120	$	9,886	$	766	$	9,120	$	4,785	$	4,335	$	771,613

Jan-11	121	121	$	9,912	$	789	$	9,123	$	4,758	$	4,365	$	767,248
Feb-11	122	122	$	9,912	$	789	$	9,123	$	4,731	$	4,392	$	762,857
Mar-11	123	123	$	9,912	$	789	$	9,123	$	4,704	$	4,419	$	758,438
Apr-11	124	124	$	9,912	$	789	$	9,123	$	4,677	$	4,446	$	753,992
May-11	125	125	$	9,912	$	789	$	9,123	$	4,650	$	4,473	$	749,519
Jun-11	126	126	$	9,912	$	789	$	9,123	$	4,622	$	4,501	$	745,018
Jul-11	127	127	$	9,912	$	789	$	9,123	$	4,594	$	4,529	$	740,489
Aug-11	128	128	$	9,912	$	789	$	9,123	$	4,566	$	4,557	$	735,932
Sep-11	129	129	$	9,912	$	789	$	9,123	$	4,538	$	4,585	$	731,348
Oct-11	130	130	$	9,912	$	789	$	9,123	$	4,510	$	4,613	$	726,735
Nov-11	131	131	$	9,912	$	789	$	9,123	$	4,482	$	4,641	$	722,093
Dec-11	132	132	$	9,912	$	789	$	9,123	$	4,453	$	4,670	$	717,423
Jan-12	133	133	$	9,938	$	813	$	9,125	$	4,424	$	4,701	$	712,722
Feb-12	134	134	$	9,938	$	813	$	9,125	$	4,395	$	4,730	$	707,992
Mar-12	135	135	$	9,938	$	813	$	9,125	$	4,366	$	4,759	$	703,232
Apr-12	136	136	$	9,938	$	813	$	9,125	$	4,337	$	4,789	$	698,444
May-12	137	137	$	9,938	$	813	$	9,125	$	4,307	$	4,818	$	693,625
Jun-12	138	138	$	9,938	$	813	$	9,125	$	4,277	$	4,848	$	688,777
Jul-12	139	139	$	9,938	$	813	$	9,125	$	4,247	$	4,878	$	683,900
Aug-12	140	140	$	9,938	$	813	$	9,125	$	4,217	$	4,908	$	678,992
Sep-12	141	141	$	9,938	$	813	$	9,125	$	4,187	$	4,938	$	674,053
Oct-12	142	142	$	9,938	$	813	$	9,125	$	4,157	$	4,969	$	669,085
Nov-12	143	143	$	9,938	$	813	$	9,125	$	4,126	$	4,999	$	664,085
Dec-12	144	144	$	9,938	$	813	$	9,125	$	4,095	$	5,030	$	659,055
Jan-13	145	145	$	9,965	$	837	$	9,127	$	4,064	$	5,063	$	653,992
Feb-13	146	146	$	9,965	$	837	$	9,127	$	4,033	$	5,094	$	648,898
Mar-13	147	147	$	9,965	$	837	$	9,127	$	4,002	$	5,126	$	643,772
Apr-13	148	148	$	9,965	$	837	$	9,127	$	3,970	$	5,157	$	638,614
May-13	149	149	$	9,965	$	837	$	9,127	$	3,938	$	5,189	$	633,425
Jun-13	150	150	$	9,965	$	837	$	9,127	$	3,906	$	5,221	$	628,204
Jul-13	151	151	$	9,965	$	837	$	9,127	$	3,874	$	5,253	$	622,951
Aug-13	152	152	$	9,965	$	837	$	9,127	$	3,842	$	5,286	$	617,665
Sep-13	153	153	$	9,965	$	837	$	9,127	$	3,809	$	5,318	$	612,346
Oct-13	154	154	$	9,965	$	837	$	9,127	$	3,776	$	5,351	$	606,995
Nov-13	155	155	$	9,965	$	837	$	9,127	$	3,743	$	5,384	$	601,611
Dec-13	156	156	$	9,965	$	837	$	9,127	$	3,710	$	5,417	$	596,194
Jan-14	157	157	$	9,991	$	862	$	9,129	$	3,677	$	5,453	$	590,741
Feb-14	158	158	$	9,991	$	862	$	9,129	$	3,643	$	5,486	$	585,255
Mar-14	159	159	$	9,991	$	862	$	9,129	$	3,609	$	5,520	$	579,735
Apr-14	160	160	$	9,991	$	862	$	9,129	$	3,575	$	5,554	$	574,181
May-14	161	161	$	9,991	$	862	$	9,129	$	3,541	$	5,588	$	568,593
Jun-14	162	162	$	9,991	$	862	$	9,129	$	3,506	$	5,623	$	562,970
Jul-14	163	163	$	9,991	$	862	$	9,129	$	3,472	$	5,657	$	557,313
Aug-14	164	164	$	9,991	$	862	$	9,129	$	3,437	$	5,692	$	551,620
Sep-14	165	165	$	9,991	$	862	$	9,129	$	3,402	$	5,727	$	545,893
Oct-14	166	166	$	9,991	$	862	$	9,129	$	3,366	$	5,763	$	540,130
Nov-14	167	167	$	9,991	$	862	$	9,129	$	3,331	$	5,798	$	534,332
Dec-14	168	168	$	9,991	$	862	$	9,129	$	3,295	$	5,834	$	528,498
Jan-15	169	169	$	10,019	$	888	$	9,130	$	3,259	$	5,871	$	522,627
Feb-15	170	170	$	10,019	$	888	$	9,130	$	3,223	$	5,908	$	516,719
Mar-15	171	171	$	10,019	$	888	$	9,130	$	3,186	$	5,944	$	510,775
Apr-15	172	172	$	10,019	$	888	$	9,130	$	3,150	$	5,981	$	504,795
May-15	173	173	$	10,019	$	888	$	9,130	$	3,113	$	6,017	$	498,777
Jun-15	174	174	$	10,019	$	888	$	9,130	$	3,076	$	6,055	$	492,723
Jul-15	175	175	$	10,019	$	888	$	9,130	$	3,038	$	6,092	$	486,631
Aug-15	176	176	$	10,019	$	888	$	9,130	$	3,001	$	6,129	$	480,501
Sep-15	177	177	$	10,019	$	888	$	9,130	$	2,963	$	6,167	$	474,334
Oct-15	178	178	$	10,019	$	888	$	9,130	$	2,925	$	6,205	$	468,129
Nov-15	179	179	$	10,019	$	888	$	9,130	$	2,887	$	6,244	$	461,885
Dec-15	180	180	$	10,019	$	888	$	9,130	$	2,848	$	6,282	$	455,603
Jan-16	181	181	$	10,046	$	915	$	9,131	$	2,810	$	6,322	$	449,281
Feb-16	182	182	$	10,046	$	915	$	9,131	$	2,771	$	6,361	$	442,920
Mar-16	183	183	$	10,046	$	915	$	9,131	$	2,731	$	6,400	$	436,520
Apr-16	184	184	$	10,046	$	915	$	9,131	$	2,692	$	6,439	$	430,081

May-16	185	185	$	10,046	$	915	$	9,131	$	2,652	$	6,479	$	423,602
Jun-16	186	186	$	10,046	$	915	$	9,131	$	2,612	$	6,519	$	417,083
Jul-16	187	187	$	10,046	$	915	$	9,131	$	2,572	$	6,559	$	410,523
Aug-16	188	188	$	10,046	$	915	$	9,131	$	2,532	$	6,600	$	403,924
Sep-16	189	189	$	10,046	$	915	$	9,131	$	2,491	$	6,640	$	397,283
Oct-16	190	190	$	10,046	$	915	$	9,131	$	2,450	$	6,681	$	390,602
Nov-16	191	191	$	10,046	$	915	$	9,131	$	2,409	$	6,723	$	383,879
Dec-16	192	192	$	10,046	$	915	$	9,131	$	2,367	$	6,764	$	377,115
Jan-17	193	193	$	10,074	$	942	$	9,132	$	2,326	$	6,806	$	370,309
Feb-17	194	194	$	10,074	$	942	$	9,132	$	2,284	$	6,848	$	363,460
Mar-17	195	195	$	10,074	$	942	$	9,132	$	2,241	$	6,891	$	356,570
Apr-17	196	196	$	10,074	$	942	$	9,132	$	2,199	$	6,933	$	349,637
May-17	197	197	$	10,074	$	942	$	9,132	$	2,156	$	6,976	$	342,661
Jun-17	198	198	$	10,074	$	942	$	9,132	$	2,113	$	7,019	$	335,642
Jul-17	199	199	$	10,074	$	942	$	9,132	$	2,070	$	7,062	$	328,580
Aug-17	200	200	$	10,074	$	942	$	9,132	$	2,026	$	7,106	$	321,474
Sep-17	201	201	$	10,074	$	942	$	9,132	$	1,982	$	7,149	$	314,325
Oct-17	202	202	$	10,074	$	942	$	9,132	$	1,938	$	7,194	$	307,131
Nov-17	203	203	$	10,074	$	942	$	9,132	$	1,894	$	7,238	$	299,893
Dec-17	204	204	$	10,074	$	942	$	9,132	$	1,849	$	7,283	$	292,610
Jan-18	205	205	$	10,103	$	971	$	9,132	$	1,804	$	7,328	$	285,283
Feb-18	206	206	$	10,103	$	971	$	9,132	$	1,759	$	7,373	$	277,910
Mar-18	207	207	$	10,103	$	971	$	9,132	$	1,714	$	7,418	$	270,492
Apr-18	208	208	$	10,103	$	971	$	9,132	$	1,668	$	7,464	$	263,028
May-18	209	209	$	10,103	$	971	$	9,132	$	1,622	$	7,510	$	255,517
Jun-18	210	210	$	10,103	$	971	$	9,132	$	1,576	$	7,556	$	247,961
Jul-18	211	211	$	10,103	$	971	$	9,132	$	1,529	$	7,603	$	240,358
Aug-18	212	212	$	10,103	$	971	$	9,132	$	1,482	$	7,650	$	232,708
Sep-18	213	213	$	10,103	$	971	$	9,132	$	1,435	$	7,697	$	225,011
Oct-18	214	214	$	10,103	$	971	$	9,132	$	1,388	$	7,745	$	217,267
Nov-18	215	215	$	10,103	$	971	$	9,132	$	1,340	$	7,792	$	209,474
Dec-18	216	216	$	10,103	$	971	$	9,132	$	1,292	$	7,840	$	201,634
Jan-19	217	217	$	10,132	$	1,000	$	9,132	$	1,243	$	7,888	$	193,745
Feb-19	218	218	$	10,132	$	1,000	$	9,132	$	1,195	$	7,937	$	185,808
Mar-19	219	219	$	10,132	$	1,000	$	9,132	$	1,146	$	7,986	$	177,822
Apr-19	220	220	$	10,132	$	1,000	$	9,132	$	1,097	$	8,035	$	169,787
May-19	221	221	$	10,132	$	1,000	$	9,132	$	1,047	$	8,085	$	161,702
Jun-19	222	222	$	10,132	$	1,000	$	9,132	$	997	$	8,135	$	153,568
Jul-19	223	223	$	10,132	$	1,000	$	9,132	$	947	$	8,185	$	145,383
Aug-19	224	224	$	10,132	$	1,000	$	9,132	$	897	$	8,235	$	137,147
Sep-19	225	225	$	10,132	$	1,000	$	9,132	$	846	$	8,286	$	128,861
Oct-19	226	226	$	10,132	$	1,000	$	9,132	$	795	$	8,337	$	120,524
Nov-19	227	227	$	10,132	$	1,000	$	9,132	$	743	$	8,389	$	112,135
Dec-19	228	228	$	10,132	$	1,000	$	9,132	$	692	$	8,440	$	103,695
Jan-20	229	229	$	10,161	$	1,030	$	9,131	$	639	$	8,492	$	95,203
Feb-20	230	230	$	10,161	$	1,030	$	9,131	$	587	$	8,544	$	86,659
Mar-20	231	231	$	10,161	$	1,030	$	9,131	$	534	$	8,597	$	78,062
Apr-20	232	232	$	10,161	$	1,030	$	9,131	$	481	$	8,650	$	69,413
May-20	233	233	$	10,161	$	1,030	$	9,131	$	428	$	8,703	$	60,709
Jun-20	234	234	$	10,161	$	1,030	$	9,131	$	374	$	8,757	$	51,953
Jul-20	235	235	$	10,161	$	1,030	$	9,131	$	320	$	8,811	$	43,142
Aug-20	236	236	$	10,161	$	1,030	$	9,131	$	266	$	8,865	$	34,277
Sep-20	237	237	$	10,161	$	1,030	$	9,131	$	211	$	8,920	$	25,357
Oct-20	238	238	$	10,161	$	1,030	$	9,131	$	156	$	8,975	$	16,382
Nov-20	239	239	$	10,161	$	1,030	$	9,131	$	101	$	9,030	$	7,352
Dec-20	240	240	$	10,161	$	1,030	$	9,131	$	45	$	7,352	$	-
Jan-21	241	241	$	-	$	-	$	-	$	-	$	-	$	-
Feb-21	242	242	$	-	$	-	$	-	$	-	$	-	$	-
Mar-21	243	243	$	-	$	-	$	-	$	-	$	-	$	-
Apr-21	244	244	$	-	$	-	$	-	$	-	$	-	$	-
May-21	245	245	$	-	$	-	$	-	$	-	$	-	$	-
Jun-21	246	246	$	-	$	-	$	-	$	-	$	-	$	-
Jul-21	247	247	$	-	$	-	$	-	$	-	$	-	$	-
Aug-21	248	248	$	-	$	-	$	-	$	-	$	-	$	-

Sep-21	249	249	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Oct-21	250	250	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Nov-21	251	251	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Dec-21	252	252	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jan-22	253	253	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Feb-22	254	254	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Mar-22	255	255	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Apr-22	256	256	$	-	$	-	$	-	$	-	$	-	$	-	$	-
May-22	257	257	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jun-22	258	258	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jul-22	259	259	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Aug-22	260	260	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Sep-22	261	261	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Oct-22	262	262	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Nov-22	263	263	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Dec-22	264	264	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jan-23	265	265	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Feb-23	266	266	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Mar-23	267	267	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Apr-23	268	268	$	-	$	-	$	-	$	-	$	-	$	-	$	-
May-23	269	269	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jun-23	270	270	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jul-23	271	271	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Aug-23	272	272	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Sep-23	273	273	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Oct-23	274	274	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Nov-23	275	275	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Dec-23	276	276	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jan-24	277	277	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Feb-24	278	278	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Mar-24	279	279	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Apr-24	280	280	$	-	$	-	$	-	$	-	$	-	$	-	$	-
May-24	281	281	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jun-24	282	282	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jul-24	283	283	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Aug-24	284	284	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Sep-24	285	285	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Oct-24	286	286	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Nov-24	287	287	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Dec-24	288	288	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jan-25	289	289	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Feb-25	290	290	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Mar-25	291	291	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Apr-25	292	292	$	-	$	-	$	-	$	-	$	-	$	-	$	-
May-25	293	293	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jun-25	294	294	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Jul-25	295	295	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Aug-25	296	296	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Sep-25	297	297	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Oct-25	298	298	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Nov-25	299	299	$	-	$	-	$	-	$	-	$	-	$	-	$	-
Dec-25	300	300	$	-	$	-	$	-	$	-	$	-	$	-	$	-
		Total	**$**	**2,377,345**	**$**	**189,336**	**$**	**2,188,009**	**$**	**1,047,140**	**$**	**1,139,135**				